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Advances towards the completion of the *Anthurium* Flora of Central America (Araceae, Pothoideae): contribution of thirty-one new species from Guatemala, Costa Rica and Panama

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Table of contents

Abstract

In the present paper, we include the description of 31 new species from Guatemala, Costa Rica and Panama (including one from the Panama-Colombia border), which are distributed in eight sections. The sections represented and the number of species per section are as follows: *Andiphilum* (two), *Belolonchium* (five), *Calomystrium* (five), *Cardiolonchium* (eight), *Decurrentia* (one), *Pachyneurium* (eight), *Polyneurium* (one) and *Tetraspermium* (one). Additionally, three Central American taxa are now considered to be distinct at the species level and are here elevated to specific rank; *Anthurium arcuatum*, *A. fogdeniorum*, and *A. copense*. Notes on habitat, conservation status, taxonomy and morphology are provided for each species as well as illustrations.

Key words: Aroids, Antioquia, Darién, Parque Internacional de La Amistad, Talamanca, Taxonomy

Introduction

The Pothoideae Engler (1986: 140) represents a monophyletic subfamily of Araceae, which is considered one of the first divergent lineages among the family (Nauheimer *et al.* 2012). Pothoideae is characterized by having leaf blades with reticulate minor venation, geniculate petioles and perfect perigonate flowers. Currently, this subfamily comprises 1012 described species (Boyce & Croat 2020), distributed in three living genera: *Pothos* Linnaeus (1753: 968) (Southeast Asia, Australasia and Madagascar), *Pothoidium* Schott (1853–1857: 26) (Taiwan and Malaysia), and *Anthurium* Schott (1829: 828) (Neotropics). The genus *Pedicellarum* Hotta (1976: 61) has long been considered a genus of Pothoideae, however, recently Wong *et al.* (2020) subsumed it into the genus *Pothos.*

Anthurium represents the largest genus of Pothoideae and Araceae, consists of 950 species described in total, but it is estimated that there may be about 3000 species (Boyce & Croat 2020). It is notable for being one of the most morphologically diverse genera in Araceae (Carlsen & Croat 2019); but in general terms, it is distinguished mainly by its terrestrial, rheophytic, epiphytic or nomadic vine life form, spirally arranged leaves, blades usually with collective veins along the leaf margins, 4-merous perigonate bisexual flowers arranged in a uniform spadix, variable-colored berries and seeds with copious endosperm. In the past, several botanists have used this great morphological variability to establish the infrageneric classification of *Anthurium* (Schott 1860, Engler 1905, Croat & Sheffer 1983, Croat 1991, Croat et al. 2005, Croat & Hormell 2017), which have been recently tested by modern molecular studies (Carlsen & Croat 2013a; Croat & Carlsen 2013; Carlsen & Croat 2019; Croat & Carlsen 2020). At present, the infrageneric classification of *Anthurium* comprises 20 sections, of which eight represent monophyletic groups (Carlsen & Croat 2019; Croat & Carlsen 2020). In Central America seventeen sections are present, only sections *Episeiostenium* (Schott 1860: 490) Engler (1898: 417), *Gymnopodium* Engler (1905: 60) (West Indies endemics) and *Urospadix* Engler (1878: 56) (endemic to eastern South America) are absent. Alternatively, three sections, *Andiphilum* (Schott 1860: 508) Croat (in Croat & Hormell 2017: 118), *Cordato-punctatum* Croat & Carlsen (2020: 46), and *Polyphyllium* Engler (1879: 105) are endemic (or nearly so since sect. *Polyphyllium* has one species in N. Colombia) to Central America (mostly northern Central America).

Anthurium species are common at lower and middle elevations and especially in cloud forests. They are usually true epiphytes or nomadic vines with an appressed-climbing habit on trees in understory of primary forest, less frequently on higher branches; rarely terrestrial, on rocks, but are especially abundant in open areas, along road cuts, streams and at the edges of treefalls; less frequently terrestrial under shrubs in dry forest or in open sandy areas (Croat 1988). Species diversity generally increases in Central America southwards to South America; but the richest areas of diversity are in the Andes, especially north-west South America (Croat 1986a, 1994; Reimuth & Zotz 2020). In Central America, there are 358 species distributed in 17 sections (Croat 2018). In this region, the diversity of species is mainly concentrated in Costa Rica and Panama, but the endemism is more concentrated in the Talamanca mountain range and in those relatively isolated mountains of Panama, where mid-elevation cloud forests occur ranging from 800 to nearly 2000 m. Recent studies by Ortiz *et al.* (2019) showed that some micro-endemic *Anthurium* species from eastern Panama occur in extremely restricted elevational ranges, growing only on the mountain-ridges among elfin cloud forests at more than 1000 m elevation.

Through fieldwork carried out in several poorly explored sites in Central America and the exhaustive review of herbarium specimens from almost all Central American countries, we have identified an extremely high number of new *Anthurium* species, which will be described progressively. This work is an effort to complete the study of the *Anthurium* genus within the Flora Mesoamerican project, which is led by the second author. The present paper includes the description of 31 new species from Guatemala, Costa Rica and Panama (including one from the Panama-Colombia border), in eight sections. The sections represented and the number of species per section are as follows: *Andiphilum* (Schott) Croat (two), *Belolonchium* (Schott 1860: 528) Engler (1879: 151) (five), *Calomystrium* (Schott 1860: 496) Engler (1898: 419) (five), *Cardiolonchium* (Schott 1860: 526) Engler (1898: 430) (eight), *Decurrentia* Croat (in Croat *et al.* 2005: 14) (one), *Pachyneurium* (Schott 1860: 466) Engler (1879: 134) (eight), *Polyneurium* Engler (1898: 384) (one) and *Tetraspermium* (Schott 1860: 436) Engler (1879: 106) (one). Additionally, three Central American taxa are now considered to be distinct at the species level and are here elevated to specific rank as *Anthurium arcuatum* (Croat) O.Ortiz & Croat, *stat. nov.*, *A. fogdeniorum* (Croat) O.Ortiz, M.Cedeño & Croat, *stat. nov*. and *A. copense* O.Ortiz, M.Cedeño & Croat, *stat. et nom. nov*. New species belonging to section *Porphyrochitonium* (Schott 1860: 439) Engler (1879: 116) will be described in a separate paper.

Material and methods

Herbarium specimens of *Anthurium* from Central America housed at AGUAT, BIGU, CHIP, CR, CSAT, ENCB, HEM, HNMN, INB, ITIC, LAGU, MEXU, MHES, MO, PMA, SCZ, TEFH, UCH, UJUAT, USCG, USJ and XAL, were studied. The acronyms of all herbaria mentioned in this work follow Thiers (2020). The new collections were made taking into account the methodology proposed by Croat (1985).

All suspected new species were keyed out in the Lucid *Anthurium* key, an electronic multi-choice key with all the existing published species present and with all of their characteristics digitally recorded. This key, which is based on Lucid technology (Haigh et al. 2009), operates by discarding potential species based on 69 features. Subsequently, the software leads to a number of potential species, which were then evaluated one by one by comparing the specimen directly with type specimens (from MO and PMA). In the case that some types were not found in the above-mentioned herbaria, the database of digitized plants with more than 25,000 files (descriptions and photographs) developed by Croat´s Araceae Lab at Missouri Botanical Garden, allows quick access to nearly all types and this is especially complete for the Neotropics. Another important resource is JSTOR Global Plants (Gallagher 2010).

Species descriptions are formulated based on standards established by Croat & Bunting (1979). Ecological statements are according to the Holdridge Life Zone System (Holdridge *et al.* 1971). The assessments of the conservation status of all new species were made based on the guidelines of the International Union for Conservation of Nature (IUCN 2001), using parameters such as number of locations, extent of occurrence (criterion B1) and area of occupancy (criterion B2). The extent of occurrence and area of occupancy values were computed using the GeoCAT software (Bachman *et al.* 2011).

Taxonomy – new species descriptions

Anthurium alfaroi Croat, *sp. nov.* (Fig. 1A)

Anthurium alfaroi is characterized by its epiphytic life form, short internodes, thin pale fibrous cataphylls persisting in a tight network, terete, semiglossy light greenish brown-drying petioles, narrowly ovate weakly sagittate grayish-drying gradually acuminate blades with the collective veins arising from the lower pairs of basal veins and markedly regular along the margin of the blade, a parabolic sinus, 3–4 pairs of basal veins, the first pair of which are free to the base, 5–6 pairs of broadly spreading primary lateral veins as well as by the long-pedunculate inflorescence with green erect-spreading spathe, long-pedunculate cylindroid spadix with red, prominently protruding berries.

Type:—COSTA RICA. Cartago: Cantón de Paraíso, Reserva Forestal Río Macho, Cuenca del Reventazón, Río Pejibaye, 09°40’35”N, 083°43’38”W, 1800 m, 22 July 1998, *E. Alfaro 1794* (holotype MO!, isotype CR!).

Epiphyte; **internodes** short, 1.8 cm; **cataphylls** 9.6 cm long, drying as a pale brown reticulum of persistent fibers. Leaf with **petioles** terete, 46.6 cm long, 6 mm wide, drying semiglossy, yellowish brown, thin and brittle, weakly sulcate toward apex; geniculum 2.2 cm, drying black; **blades** narrowly ovate-weakly sagittate, gradually long-acuminate, 34.1 × 20.1 cm, 1.7 times longer than broad, 0.7 times as long as petiole, dark green, semi-glossy above, paler green, matte below, drying pale gray-green above, gray-green below; **anterior lobe** 29.1 × 20.1 cm, broadest at 4 cm above petiolar plexus, broadly convex on margin; **posterior lobes** 9.1 × 7.2 cm, directed at 131°, narrowly rounded at apex; surfaces moderately smooth; **sinus** parabolic, 5 cm deep, 5.2 cm wide; **primary lateral veins** 5–6 pairs, arising at 62° angle, narrowly rounded and concolorous above, drying irregularly ridged and concolorous, narrowly acute, drying narrowly raised and paler below; **collective veins** arising from 3rd pair of basal veins, 3–5 mm from margin; upper surface epunctate; lower surface epunctate and sparsely granular; **basal veins** 3–4 pairs, 1st pair free to base, 2nd pair fused 1.7 cm, 3rd pair fused 2.8 cm; **posterior ribs** 2.8–3.2 cm long, naked 2.5–2.8 cm; tertiary veins rounded, very weakly raised above, rounded, weakly raised below; **midrib** narrowly acute and slightly paler above, bluntly acute and paler below. **Inflorescence** long-pedunculate; **peduncle** green, 39.2 cm long, drying 3 mm diam.; **spathe** green, erect-spreading, 7.3 × 2.7 cm; **spadix** long-pedunculate cylindroid, 6.8 cm long, 1.2 cm diam.; stipe 1.8 cm long, 0.2 cm diam.; **flowers** 6 visible per spiral, 4.6 × 5.0 mm; tepals granular, drying light brown, becoming markedly erect in fruit, 1.8 mm wide, inner edge rounded, outer margin 2-sided; stamens light brown, 0.4 × 0.5 mm, held at level of tepals, thecae ovate, scarcely divaricate; **berries** red, 2.8–3.3 cm long, 2–3 cm diam.

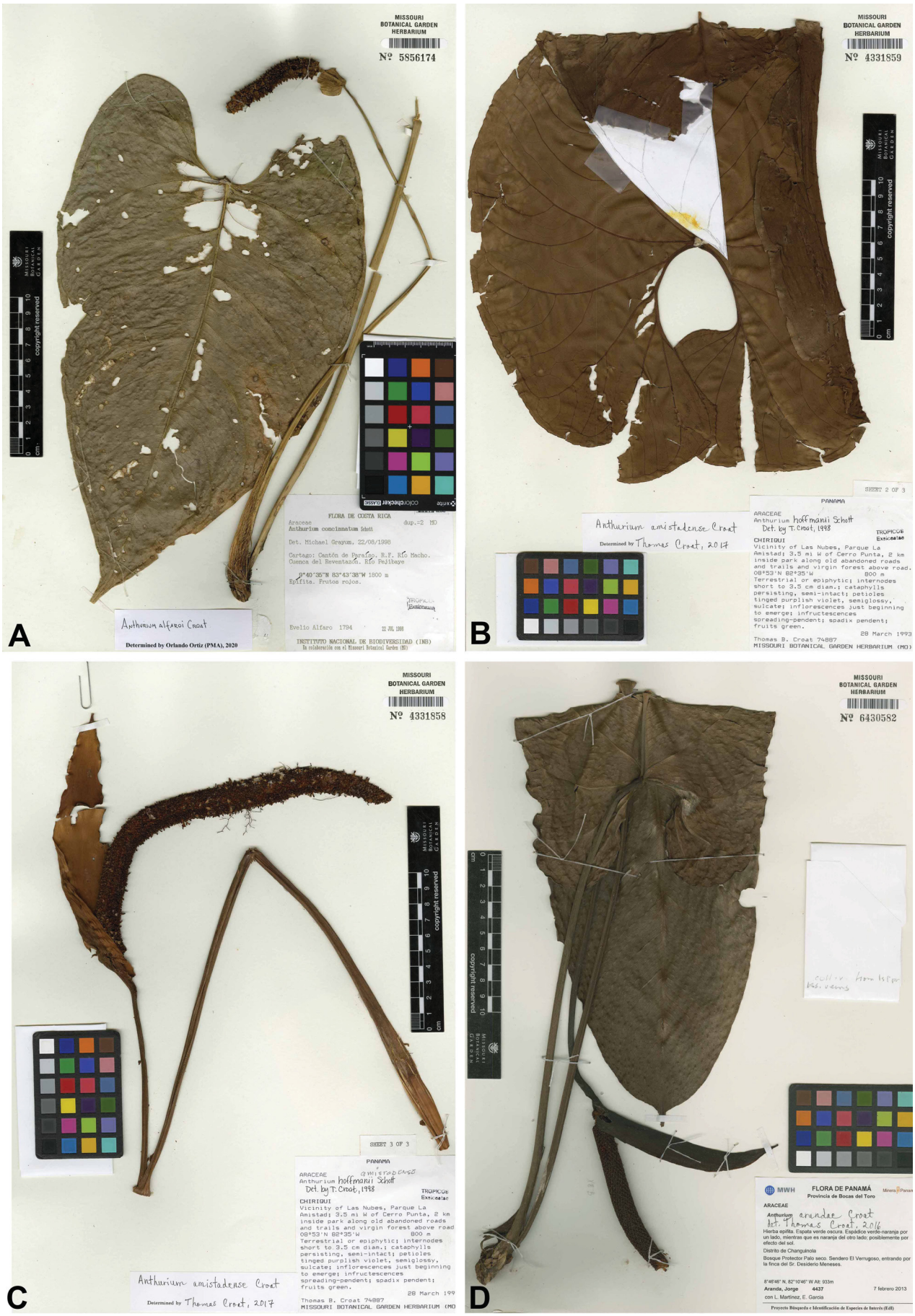

FIGURE 1. Holotype specimens: **A**. *Anthurium alfaroi* Croat. **B–C**. *Anthurium amistadense* Croat. **D**. *Anthurium arandae* Croat & O. Ortiz.

Eponymy:—The species is named in honor of Costa Rican botanist Evelio Alfaro who collected the type specimens.

Habitat and distribution:—*Anthurium alfaroi* is endemic to Costa Rica, known only from the type locality in Cartago Province in the valley of the Río Reventazón at 1800 m in a *Lower montane rain forest* life zone.

Phenology:—Flowering and fruiting in July. Further research is required to determine exact flowering and fruiting seasons.

Discussion:—The species is provisionally placed in sect. *Cardiolonchium.* The species has been confused with *A. concinnatum* Schott (1860: 522), a typical member of sect. *Belolonchium* which differs in having more coriaceous, typically more brownish-drying blades with a hippocrepiform sinus, upper surface short pale-lineate and irregularly areolate-ridged on magnification, collective veins usually arising from the primary lateral veins or the uppermost pairs of basal veins, inflorescence long-tapered, curved and more short-stipitate with orange berries. In contrast *A. alfaroi* has blades drying grayish green, e-lineate and minutely granular above and smooth below with cylindroid spadix and red berries.

In the Lucid *Anthurium* key the species tracks to the following three species: *A. cerrocampanense* Croat (1981: 316) from central Panama which differs by having sharply triangular petioles; *A. coloradense* Croat (1986b: 64), differing by having much larger leaf blades with up to 8 pairs of basal veins and to 15 pairs of primary lateral veins; and *A. panamense* Croat (1986b: 148), differing by having long and narrowly tapered leaf blades with a sessile spadix.

Conservation status:—*Anthurium alfaroi* should be considered as data deficient (DD).

***Anthurium amistadense* Croat, *sp. nov.* (Figs. 1B–C)**

Anthurium amistadense is characterized by its short thick internodes, cataphylls persisting mostly intact with pale fibers lower down, subterete sulcate petioles which are tinged purplish, broadly ovate brown-drying blades with a closed, more or less ovate sinus, a single pair of free basal veins (with a 2nd pair almost free to the base) and a long curved posterior rib, much of which is naked, collective veins arising from the upper basal veins by rather weakly developed loop connections.

Type:—PANAMA. Chiriqui: Vicinity of Las Nubes, Parque La Amistad; 3.5 mi W of Cerro Punta, 2 km inside park along old abandoned roads and trails and virgin forest above road, 800 m, 08°53'N, 82°35'W, 28 March 1993, *T.B. Croat 74887* (holotype MO!).

Terrestrial or epiphytic; **internodes** short, 3.5 cm diam.; **cataphylls** persisting, intact, 19.6 cm long, acute, becoming fibrous with fragments of reddish brown epidermis, the fibers reddish brown. Leaf with **petioles** 79.9 cm long, 7 mm diam., tinged purplish violet, subterete, semiglossy, sulcate, drying grayish yellow brown; geniculum 1.2 cm long, drying lighter than petioles; **blades** broadly ovate, 44.0 × 29.1 cm, 1.5 times longer than broad, broadest slightly above petiole attachment, 0.5 times long as petiole, acuminate at apex, prominently lobed at base, drying subcoriaceous, dark brown and matte above, yellowish brown and semiglossy below, epunctate; upper surface drying minutely areolate-bullate on magnification; lower surface moderately smooth to minutely granular; **anterior lobe** 29.5 cm long, margins broadly rounded (the distal margin not seen); **posterior lobes** 15.2 × 12.0 cm, directed downward and inward; major veins drying concolorous above, drying darker than surface below; **midrib** drying narrowly raised and slightly darker above, round-raised, finely ribbed and darker below; **primary lateral veins** 5–6 pairs, arising at 45–50° angle, drying weakly and narrowly acute, concolorous above, narrowly raised, 1–3 ribbed (sometimes acutely angular) and darker below; secondary veins and tertiary veins drying etched and concolorous above, indistinct below; **collective veins** arising from 2nd (3rd–4th) pair basal veins, 6–9 mm from margin; **basal veins** 8 (9) pairs, 1st pair free to base, 2nd pair almost free to base, 3rd pair fused to 2.1 cm, 5th and 6th pairs fused to 5.9 cm; **posterior ribs** gradually curved, naked 5.7 cm, about ¾ of its length; **sinus** closed, reniform, 15.1 cm deep, 4.9 cm wide. **Inflorescence** just beginning to emerge. **Infructescence** with **peduncle** 59.3 cm long; **spathe** green (tinged red-violet), 17.9 cm long, 3.8 cm wide, oblong-lanceolate, drying coriaceous, yellowish red-brown; **spadix** pendent, stipitate 1.1 cm**,** long and tapered, 26.4 cm long, 1.7 cm diam. at middle, drying reddish brown; **flowers** ca. 10 per spiral, tepals minutely granular on drying; lateral tepals 1.7–1.9 mm wide, the outer margins 2–3-sided, inner margin broadly rounded, drying concave and often upturned; pistils projecting beyond the general level of the tepals, densely covered with pale cellular inclusions; stamens exserted 1–2 mm above tepals. **Berries** green, apparently immature.

Eponymy:—The species name comes from the type locality in the Parque La Amistad in western Panama near the Costa Rican border.

Habitat and distribution:—*Anthurium amistadense* is known only from the type locality in Panama in Chiriquí Province at 800 m in a *Premontane rain forest* life zone.

Phenology:—Fruiting in March.

Discussion:—This species is a member of sect. *Belolonchium* and is most similar to *A. antonioanum* Croat (1986b: 34) which differs in having leaf blades with a broadly hippocrepiform sinus, green tinged red-violet, ovate spathes, shorter and wider spadices (7–17 cm long, 1.8–2.5 cm diam.). In the Lucid *Anthurium* key *A. amistadense* keys to *A. bittneri* Grayum (1992: 40) and *A. clavatum* Croat & Baker (1979: 39) both of which differ in having a respectively clavate or spindle-shaped spadix and *A. darcyi* Croat (2005: 354) differing in having prominently winged petioles.

Conservation status:—Data deficient (DD).

***Anthurium arandae* Croat & O.Ortiz, *sp. nov.* (Fig. 1D).**

Anthurium arandae is characterized by its epiphytic life form, short thick internodes, long-petiolate leaves, terete dark brown-drying petioles, narrowly ovate-sagittate, abruptly acuminate dark brown-drying blades with narrowly hippocrepiform sinus, with the lateral margins nearly straight, 4 pairs of basal veins, the 1st pair free to the base, a short posterior rib (2.5 cm long), the collective veins arising from the 1st pair of basal veins, the long-pedunculate inflorescence with an oblong-elliptic green spathe, and the subsessile, more or less cylindroid green to orange spadix which is slightly shorter than the spathe.

Type:—PANAMA. Bocas del Toro: Distrito Changuinola, Bosque Protector Palo Seco, Sendero El Verrugoso, entrando por la finca de Sr. Desiderio Meneses, 08°46'46"N, 82°10'46"W, 933 m, 7 Feb 2013, *J. Aranda, L. Martínez & E. García 4437* (holotype MO!).

Epiphytic; **internodes** short ca. 5 mm long, 1.5 cm diam.; **cataphylls** persisting semi-intact, ca. 5 cm long, dark brown, thinly coriaceous. Leaves erect; **petioles** 32 cm long, 5 mm diam., terete, narrowly and acutely sulcate, drying medium brown, matte; petiolar sheath prominent, 7 cm long; geniculum 2 cm long, noticeably darker than petiole; **blades** narrowly ovate-sagittate, 40.5 × 16.5 cm, widest 4 cm above petiolar plexus, abruptly and narrowly acuminate (acumen 1.2 cm long, aristate), 2.5 times longer than wide, 1.3 times as long as petiole, subcoriaceous, drying medium brown and matte above and somewhat paler, semiglossy below; **anterior lobe** 33 cm long, weakly concave in the middle third of the blade becoming gently convex in the distal third; **posterior lobes** 8.0 × 5.5–6.0 cm; upper surface obscurely and densely short pale-lineate, densely pale-speckled, sparsely pustular; lower surface moderately smooth, sparsely dark dotted, dots with pale centers; **sinus** narrowly hippocrepiform, 7 cm deep; **primary lateral veins** 6–7 pairs, arising at a 47–53° angle, barely more prominent than interprimary veins, narrowly convex to thicker than broad above and narrowly rounded below, most lateral veins prominently undulate; tertiary veins slightly raised above and below, slightly darker above and concolorous below; **collective veins** arising from the 2nd pair of basal veins, 3–5 mm from margin; **basal veins** 5 pairs, 1st pair free to base, 2nd pair coalesced to 4 mm, 3rd and 4th coalesced to 1.5 cm, 4th and 5th to 1 cm, narrowly convex; **posterior ribs** 2.5 cm long, naked for 0.5 cm, convex below, almost straight near the petiolar plexus curving strongly farther away; **midrib** thicker than broad above, convex with a very weak medial rib below. **Inflorescence** erect; **peduncle** 64.5 cm long, 4 mm diam. midway, 5.5 times longer than petiole, broadly and obtusely sulcate, medium yellow-brown, matte; **spathe** 12 × 3 cm, oblong, erect-spreading, subcoriaceous, dark green, conduplicate on drying, drying very dark brown; **spadix** subsessile (stipe ca. 1–2 mm long), 10.5 cm long, 1.3 cm diam. midway, cylindrical slightly tapering near apex, green to orange, drying dark reddish brown, slightly shorter than spathe; **flowers** 11–12 per spiral, 2.4–2.6 × 2.7–3.0 mm, tepal surface with a crusteose substance that can be scraped off; lateral tepals 1.5 mm wide, outer margin 2–3 sided, inner margin broadly rounded usually prominently directed upward and often undulate, stamens not seen. **Berries** not seen.

Eponymy:—The species is named in honor of the Panamanian botanist Jorge Aranda, who along with L. Martínez and E. García collected the type specimen. Mr. Aranda is a notable Panamanian botanist who has stood out for being an excellent collector, as well as for carrying out various physiological studies of CAM species.

Habitat and distribution:—*Anthurium arandae* is endemic to Panama, known only from the type locality in Bocas del Toro Province at 933 m, in a *Premontane rain forest* life zone. Owing to its relatively proximity to Costa Rica, the species might also occur in that country.

Phenology:—Flowering in February.

Discussion:—*Anthurium arandae* (sect. *Calomystrium*) in the Lucid *Anthurium* key tracks to *Anthurium flavoviride* Engler (1898: 447), *A. hoffmannii* Schott (1858: 181), *A. modicum* Croat & Oberle (2004: 64), *A. obtusilobum* Schott (1858: 181) and *A. cucullispathum* Croat (1986b: 77). *Anthurium flavoviride* differs in having a purple spathe with yellowish green veins; *A. hoffmannii* differs in having a more ovate blade, a parabolic sinus, and a spadix that becomes white or cream; *A. modicum* differs in having a blade that is more broadly ovate and a peduncle that is half as long as the petiole; *A. obtusilobum* differs in having 8 pairs of basal veins, collective veins that arise from the lowermost

basal veins and a spadix that turns lavender to purple-violet; *A. cucullispathum* differs in having leaf blades with inconspicuous posterior ribs, parabolic to hippocrepiform sinus and spadices with 7–8 flowers visible in the principal spiral.

Conservation status:—Data deficient (DD).

Anthurium armbrusteri Croat, *sp. nov.* (Fig. 2A)

Anthurium armbrusteri is characterized by its small size, epiphytic life form, short internodes, densely arranged tangled roots, short cataphylls persisting as red-brown fibers, short-petiolate leaves, triangular-sulcate petioles, narrowly ovate to ovate-elliptic subcoriaceous gray-drying gradually acuminate blades which are rounded at base, have a single pair of basal veins and moderately obscure primary lateral veins as well as a slender peduncle oval in cross-section with a green linear-lanceolate erect-spreading spathe and a very slender moderately elongated yellow-orange spadix with no more than 3 flowers visible per spiral.

Type:—PANAMA. Coclé: Logging camp 12 mi from Llano Grande, 700 m, 08°45'30"N, 80°31'36"W, 11 Dec 1983, *H.W. Churchill, A. Lieri, W.S. Ambruster & A. Herzig 4079* (holotype MO!).

Epiphyte; roots densely tangled; **internodes** short, 5 mm diam.; **cataphylls** 1.6 cm long, persisting as mostly closely parallel fibers with fragments of reddish brown epidermis. Leaves with **petioles** 2.2–3.7 cm long, 2 mm diam., wedge-shaped (triangular in cross-section), sharply sulcate adaxially, drying yellowish brown; geniculum 4–5 mm long, drying concolorous with petioles; **blades** narrowly ovate to ovate-elliptic 7.9–10.4 × 3.2–4.5 cm (averaging 10 × 4 cm), 2.2–2.8 (averaging 2.5) times longer than broad, broadest at lower half, 2.2–3.7 (averaging 3.1) times long as petioles, gradually acuminate at apex (acumen to 5 mm long), rounded at base, drying subcoriaceous, brownish gray, matte above, grayish brown and weakly glossy below, epunctate; upper surface minutely granular-areolate, sometimes ridged, frequently minutely blackish-speckled; lower surface minutely granular and densely blackish-speckled below; **midrib** drying narrowly raised, finely ribbed and paler above, narrowly rounded, finely ribbed and darker below; **primary lateral veins** 8 pairs, arising at 50° angle near middle, drying weakly and narrowly raised, concolorous above, narrowly rounded, darker below; secondary veins and tertiary veins drying moderately distinct above and below; **collective veins** arising from 1st pair basal veins, 4 mm from margin; basal veins 1 pair; anti-marginal (one immediately adjacent to the margin) vein present. **Inflorescence** erect; **peduncle** 8.7–8.9 cm long, oval in cross-section, winged adaxially; **spathe** green, erect-spreading, 3.7 × 6.0 cm, linear-lanceolate, drying moderately coriaceous, reddish brown; **spadix** yellow-orange, sessile, very slender moderately elongated, 3.1–3.2 cm long, 2 mm diam., drying reddish brown; **flowers** 3 visible per spiral, drying 1.7 × 1.6 mm; tepals minutely granular on drying; lateral tepals 1.2 mm wide, inner margin rounded, outer margins 2-sided; stamens held at level of tepals, 0.4 mm long, 1.2 mm wide; thecae broadly ovate, markedly divaricate. **Berries** not seen.

Eponymy:—The species is named in honor of American biologist W. Scott Armbruster, who collected the type specimen. Armbruster is a staff member at the University of Portsmouth in the United Kingdom and at the University of Alaska, USA. He collected the type specimen while doing fieldwork on the genus *Dalechampia* Linnaeus (1753: 1054) (Euphorbiaceae) in Panama in 1983. At that time, he was working on pollination, evolution, and systematics of *Dalechampia* vines while also doing some general collecting. He has continued his work with *Dalechampia*, most recently in Costa Rica and Madagascar.

Habitat and distribution:—*Anthurium armbrusteri* is known only from the type locality in Panama in Coclé Province at 700 m in a *Premontane moist forest* life zone.

Phenology:—Flowering in December.

Discussion:—The species is a member of sect. *Decurrentia*. In this section, *A. armbrusteri* is similar to *A. platyrhizum* Croat (1986b: 160) which differs by having a dense mass of conspicuously flattened roots, narrowly elliptic to oblanceolate-elliptic leaf blades, boat-shaped acuminate spathes and spadices with 4–5 flowers visible in the alternate spiral. Also, *A. armbrusteri* closely resembles *A. crassiradix* Croat (1986b: 70) but that species is a member of sect. *Porphyrochitonium* Schott (1860: 439) with dark glandular-punctate leaves and longer petioles, blades that are typically much longer and usually have a reduced secondary pair of basal veins. In addition, the stamens of *A. crassiradix* remain emergent, not withdrawn under the tepals as on *A. armbrusteri*.

Conservation status:—This species is only known from a single locality and comprises an area of occupancy of 4 km^2. The greatest threat this species is facing is the loss of habitat caused by destructive livestock activities. The area where this species occurs consists of a matrix of pastures with some secondary nearby forests. Because human and livestock activities threatens the integrity of this area, we consider that *A. armbrusteri* can be assessed as a critically endangered species, CR B2ab(ii,iii,iv).

FIGURE 2. Holotype specimens: **A**. *Anthurium armbrusteri* Croat. **B**. *Anthurium carlablackiae* Croat & O. Ortiz.

Anthurium carlablackiae Croat & O.Ortiz, *sp. nov.* (Fig. 2B, 3)

Anthurium carlablackiae is characterized by its short internodes, velvety broadly ovate blades with pale major veins, free basal veins with the collective veins arising from the 1st pair of basal veins and very remote from margin, and by its erect inflorescence with a narrowly ovate, whitish enshrouding spathe and a short, cylindrical yellow-green spadix.

Type:—PANAMA. Comarca Guna Yala, vic. Puerto Obaldía near the border with Colombia on the Caribbean coast, slightly E of village, 08°39'N, 77°23'W, ca. 300 m, collected originally by Carla Black on Sept. 2009 (vouchered by T. Croat on 15 Dec 2009), *T.B. Croat 101490* (holotype MO!, isotypes COL!, K!, PMA!, US!).

Terrestrial; **internodes** short, to 3 cm diam.; **cataphylls** 5.5–6.8 cm long, narrowly triangular, drying intact and dark brown. Leaves 2–3 per plant; **petioles** erect-spreading, 12.6–25.5 cm long, 3–6 mm diam., sharply sulcate adaxially, markedly 3-ribbed abaxially, tinged purplish violet, sheathed 3.3–5.0 cm; geniculum 1.0–1.2(2.5) cm long, about as broad as the petiole, sharply sulcate adaxially, acutely angular abaxially; **blades** ovate-cordate, 21.0–35.4 × 13.5–23.1 cm, 1.2–1.6 times longer than broad, 1.1–1.9 times as long as petioles, held more or less horizontal or at ca. 45° from petioles, abruptly acuminate at apex, cordate at base, dark green and velvety above, moderately paler and matte below; **anterior lobe** 20.6–29.0 cm long, 16.1–23.0 cm wide, broadly rounded along margins; **posterior lobes** narrowly rounded, 5.5–6.5 × 6.5–8.5 cm, directed at 141–152° angle from the midrib; upper surface densely granular-ridged in a cranioid pattern; lower surface smooth with sparse pustules, subareolate at higher magnifications; **sinus** 4.3–6.4 cm deep, 0.9–1.3 cm wide, narrowly v-shaped and almost closed, overlapping when flattened; basal veins and primary lateral veins markedly paler on the upper surface with a broad discolored band along both margins; **primary lateral veins** 2–3 pairs, arising at 30–45° angle, those near the apex quilted-sunken, concolorous above, weakly raised below; **collective veins** arising from 1st pair basal veins and 3.5–4.3 cm from margin of middle of the blade; upper surface conspicuously ridged-granular, less shiny; lower surface ridged-granular; **basal veins** 4 pairs, all free to the base, 2nd

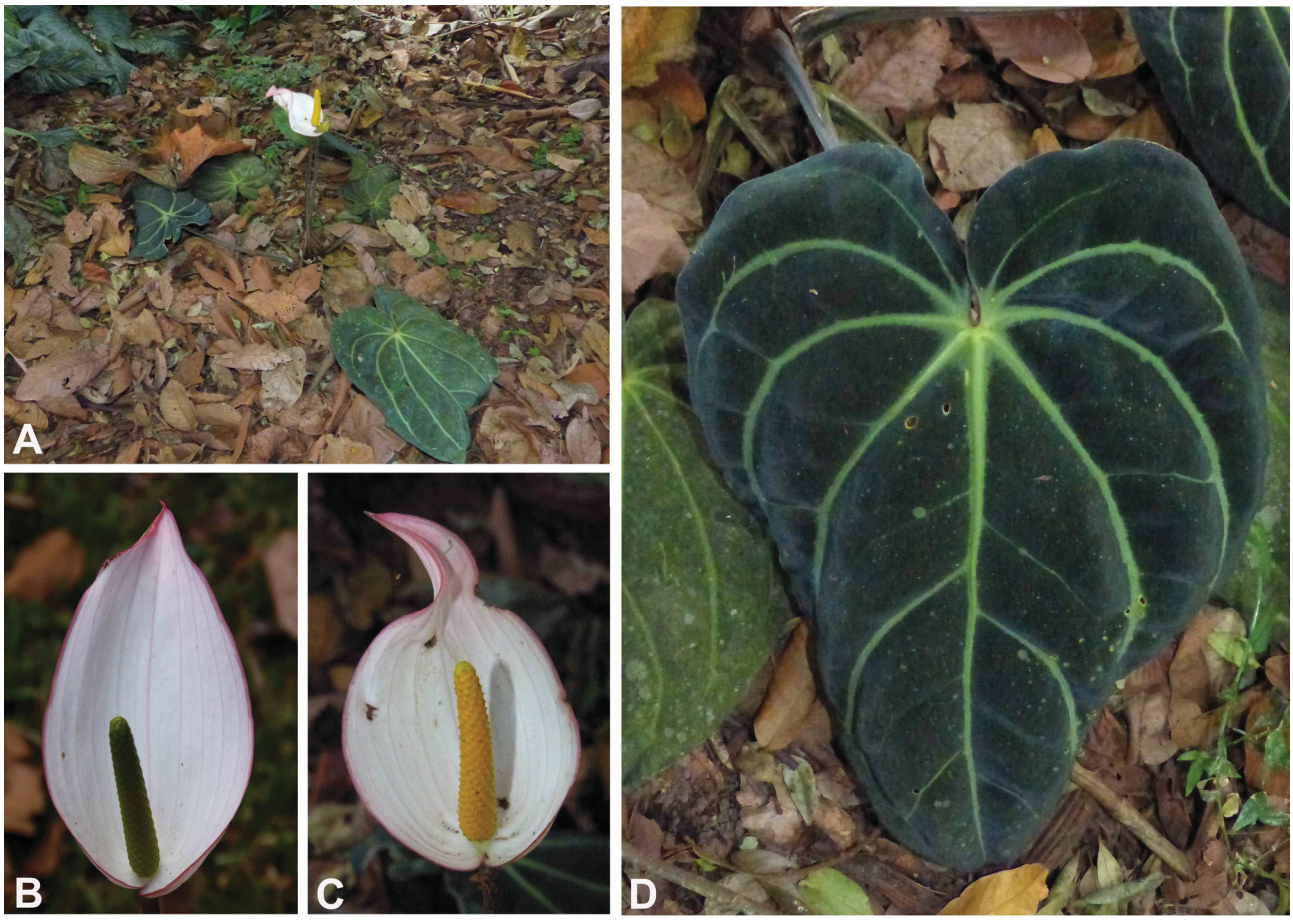

FIGURE 3. *Anthurium carlablackiae* Croat & O. Ortiz: **A**. Habit. **B**. Inflorescence (pre-anthesis). **C**. Inflorescence (at anthesis). **D**. Leaf blades (adaxial surface). Photo credits: Orlando O. Ortiz.

basal vein extending nearly to apex; posterior ribs lacking; tertiary veins very weak above and below; **midrib** narrowly rounded to about the middle, flattened toward the apex above, tinged purplish and weakly raised below in lower half, narrowly rounded toward apex below. **Inflorescence** erect; **peduncle** 17.2–32.5(41.3) cm long, 3.7 mm diam., purplish red, subvelvety-matte; **spathe** ovate-elliptic, 5.0–9.4(11) × 2.2–5.2(7.7) cm (when flattened), 1.3–2.0 times longer than wide, white, tinged pinkish along the margins, erect and more or less enshrouding spadix, (4 cm wide when flattened), abruptly acuminate at apex and somewhat clasping at base, with 3 veins on either side of midrib; **spadix** yellow-green, 2.2–5.2 cm long, 7 mm diam. at base, 6 mm diam. near apex, cylindroid, rounded at apex, glossy; **flowers** 6 visible per spiral, 4-lobed, 2.7–2.8 × 1.9–2.5 mm; tepals smooth, lateral tepals 0.9–1.0 mm wide, sub-shield-shaped, the outer margins obtusely to acutely 3–4-sided, rarely 2-sided, inner margins usually rounded, sometimes obtusely 2-sided. **Infructescence** to 8.5 cm long, 1.5–1.8 cm wide. **Berries** white, violet-purple at apex.

Eponymy:—The species is named in honor of Mrs. Carla Black, a horticulturist living in Chiriquí Province of Panama who discovered the species while searching for her favorite group, Heliconiaceae. Carla is an intrepid explorer who has visited many parts of Panama and she was kind enough to share with me material of this beautiful new species.

Habitat and distribution:—*Anthurium carlablackiae* is known only from the SE corner of Panama and in adjacent Colombia at 500 m elevation in a *Tropical wet forest* life zone. The species has also been seen near the Cana gold mine site below the Alturas de Nique in the Serranía de Pirre by Carla Black but no voucher was prepared. The Colombian collection is based on a single cultivated collection which was obtained from a tourist who was given the seed by a local vendor. It is fortunate that this collection extends the range to Colombia.

Phenology:—Flowering in January, March and September.

Discussion:—*Anthurium carlablackiae* (sect. *Cardiolonchium*) is most closely related to *A. crystallinum* Linden & André (in Linden 1873: 3) which shares similar matte-subvelvety blades with pale veins and a yellow spadix but that species differs in having a narrowly lanceolate green spathe which is spreading as well as by having a rather long-tapered spadix 15–25 cm long. In contrast *A. carlablackiae* has an ovate spathe that is 1.3–2.0 times longer than wide

and somewhat enshrouds the spadix at the base and is tinged pinkish. The Colombian collection (*Croat 103526*) differs from the Panamanian collections in having a proportionately longer, slightly tapered spadix.

Conservation status:—Currently, there is not sufficient information to support a successful conservation assessment based on distribution or population status for this species, we therefore propose *A. carlablackiae* to be listed as data deficient (DD).

Additional specimens examined (paratypes):—COLOMBIA. Antioquia: Vic. of Turbo, 500 m, specimen prepared from a collection in cultivation, 23 Jan., 2012, *T.B. Croat 103526* (COL!, MO!). PANAMA. Planta cultivada, originaria de Puerto Obaldía, Comarca Guna Yala, 08°39'N, 77°23'W, ca. 300 m, collected originally by Carla Black on Sept. 2009 (vouchered by O. Ortiz on 12 March 2016), *O.O. Ortiz 2609* (MO!, PMA!).

***Anthurium castillomontii* Croat, Vannini & Hormell, *sp. nov.* (Figs. 4A, 5)**

Anthurium castillomontii is characterized by its large size, terrestrial habit, subterete petioles, large sagittate blades which dry grayish green on upper surface and pale grayish yellow-green on lower surface, have usually 6 pairs of basal veins, a well-developed posterior rib which is naked nearly ¾ its length, as well as by its prominently protruding pistils.

Type:—GUATEMALA. Izabal: Above Aldea Las Pavas on northeastern facing foothills of Cerro San Gil, Cerro San Gil, Izabal, 200 m north of radio array, Tropical wet forest (Bosque muy humedo tropical), 015°41'18"N, 88°41'35"W, 949 m, 28 Jan 2002, *J.J. Castillo Mont 3113* (holotype MO!, isotypes AGUAT!, B!, F!, K!, MEXU!, NY!, PMA!,TEFH!, US!).

Terrestrial; **internodes** short 2.2–4.0 cm diam.; **cataphylls** thick and persisting intact at upper nodes then deciduous, the petiole scars conspicuously sunken. Leaves with **petioles** 68 cm long, subterete, only weakly sulcate adaxially, drying pale yellowish green, closely longitudinally ridged with a deep, narrow sulcus with bluntly acute margins, sometimes with a narrow medial rib; geniculum 3.5 cm long, drying brown and more slender than the remainder of petiole; **blades** 69–75 × 40–43 cm, subcoriaceous, semiglossy, moderately bicolorous, drying dark grayish green above, much paler and light yellow-green below; **anterior lobe** 29–55 × 38–42 cm, narrowly rounded at apex; **posterior lobes** 27–28 cm long; **sinus** spathulate to narrowly hippocrepiform; major veins narrowly rounded and raised above; **basal veins** 6(–7) pairs, the 1st pair free to the base, the 3rd and higher pairs fused 6–8 cm; **posterior ribs** broadly curved, naked 6–8 cm long along the sinus; **midrib** narrowly raised, bluntly acute and slightly paler above, narrowly round-raised and paler below; **primary lateral veins** 3–4 pairs, arising at 60–65° angle then curved upward toward apex; **collective veins** arising from the 1st pair of basal veins, extending along the margin at 1.0–1.5 cm distance, sunken above, raised below; tertiary veins drying in part weakly raised and concolorous below; **upper surface** minutely granular to areolate-ridged; **lower surface** minutely granular, both lacking short pale lineations. **Inflorescence** erect; **peduncle** 31 cm long, drying heavily ridged, drying 4 mm diam., 14.5 cm long, drying 2.2 cm diam.; **spathe** 8.0–10.0 × 2.5–3.0 cm, spreading, curved downward, turning dark purple in age; **spadix** 14 cm long, 2.8 cm diam, greenish, tinged purplish pre-anthesis, becoming dark purple post-anthesis, the pistils early-emergent; **flowers** 10 in principal spirals, 6–7 visible in the alternate spiral; tepals 2.6–3.6 mm wide, outer margins 2-sided, inner margin broadly rounded, inner surface of tepals densely short-dark-lineate midway; pistils protruding; styles drying 0.8–1.0 mm diam. **Berries** early-emergent, green, mature berries not seen.

Eponymy:—The species is named for botanist Juan José Castillo Mont. Juan is a tenured professor in the Facultad de Agronomía at the Universidad de San Carlos de Guatemala and curator of the herbarium there (AGUAT). He is a very well-known Guatemalan botanist who, together with Donald Hodel, has published extensively on the palms of Guatemala and Honduras. He is also very interested in regional aroids, and has a large collection of Central American and Mexican *Anthurium* spp. in cultivation at his home.

Habitat and distribution:—*Anthurium castillomontii* is endemic to Guatemala, known only from the type locality on Cerro San Gil at about 900 m in a *Tropical wet forest* life zone.

Phenology:—Flowering and fruiting in July. Further research is required to determine exact flowering and fruiting seasons.

Discussion:—This species is a member of sect. *Andiphilum*. *Anthurium castillomontii* is most similar to *A. lancetillense* Croat (1983: 308), a seemingly close relative from lower elevations in Guatemala and Honduras. *Anthurium lancetillense* differs by having smaller blades (38–54 × 20–35 cm) which are glossier with sunken major veins (except near midrib) on the upper surface as well as a much shorter peduncle and more long-tapered dark purple spadix in contrast to a shorter cylindroid-tapered green-purple spadix. Moreover, on the Holdridge life zone map of Guatemala *A. castillomontii* is mapped as *Tropical wet forest* whereas *A lancetillense* is mapped as *Subtropical wet*

FIGURE 4. Types specimens: **A**. *Anthurium castillomontii* Croat (holotype). **B–D**. *Anthurium clewellii* Croat & O. Ortiz (isotype).

forest. The Lucid *Anthurium* Key also tracks to *A. titanium* Standley & Steyermark (1947: 211) but that species has the petioles prominently sulcate and rough whereas *A. castillomontii* has petioles terete and smooth; *A. montanum* Hemsley (1879: 36) differs by having usually D-shaped petioles and 6–11 primary lateral veins.

Conservation status:—Data deficient (DD).

Anthurium clewellii Croat & O.Ortiz, *sp. nov.* (Figs. 4B–D, 6)

Anthurium clewellii is characterized by its moderately large size, epiphyte life form, appressed-climbing habit, short thick internodes, cataphylls persisting as fibers, terete petioles, broadly ovate-sagittate grayish- to dark brown- drying, abruptly acuminate blades, the mitered to hippocrepiform sinus, usually 10 to 11 pairs of basal veins with none or the 1st pair free to the base, a weakly curved posterior rib which is naked much of its length, collective veins arising from one of the lower basal veins 1–2(–3) mm from the margin as well as by the short peduncle, the greenish spathe with reddish lines and the stipitate bright yellow spadix.

Type:—PANAMA. Darién: Parque Nacional Darién, Serranía de Pirre, Rancho Plástico, 07°58'54"N, 77°42'30"W, 1128 m, 31 July 2016, *O. O. Ortiz, R. Flores, E. Campos, Y. Guadalupe & C. Quiróz 2660* (holotype PMA!, isotypes FT!, MO!).

Appressed epiphyte; stem 60 cm long; **internodes** short, 5 cm diam.; **cataphylls** to 23 cm long, persisting as pale brown, closely spaced, medium brownish red fibers. Leaves with **petioles** terete, 120–123 cm long, drying to grayish brown, smooth, matte, finely ribbed on magnification, 1.0–1.5 cm wide midway; **blades** subcoriaceous, broadly ovate-sagittate, 87–104 × 61–75 cm, 1.3–1.4 times longer than wide, drying grayish to dark brown, matte above, yellowish gray-brown, weakly glossy on below; **anterior lobe** 71–78 cm long, abruptly acuminate at apex, broadly convex at margins; **posterior lobes** broadly rounded, 19–34 × 25–27 cm, directed toward the base then distinctly curved inward; **sinus** mitered to hippocrepiform, 15.0–25.5 cm deep, (10)21–24 cm wide; **basal veins** (9)10–11 pairs, drying dark yellow-brown, 0–1 free to the base, 6th & 7th fused 11–12 cm, 8th & 9th fused 13–14 cm; usually 7 of them acroscopic, 4 basioscopic; **posterior ribs** weakly curved, naked 9–14 cm, major veins convex on both surfaces; **primary lateral veins** 11–12 pairs, arising at a steep angle then spreading at 50–60° angle; **collective veins** arising from one of the lower basal veins, extending to the apex 1–2(–3) mm from the margin. **Inflorescence** with **peduncle** 14 cm long, drying 3.5 mm diam., dark brown, matte; **spathe** 16 × 5 cm, greenish with reddish lines; **spadix** stipitate for 6 mm, 11 cm long, 1.4 cm diam.; **flowers** 14–15 visible per spiral, 2 mm long, lateral tepals 1.2–1.3 mm wide, inner margins rounded, turned up against the pistil, outer margins 2-sided; stamens exserted to 3 mm; anthers 1.0–1.2 mm long, 0.6 mm wide, thecae not at all divaricate. **Infructescence** spreading-pendent; peduncle ca. 60 cm long (lost); fruiting spadix 49 cm long, 4.5–5.0 cm diam. at base, 2.5–3.0 cm diam. near the apex, red-maroon. **Berries** early emergent, narrowly acute at apex, the apical 1/2 red-maroon, the basal 1/2 white, not exposed.

Eponymy:—The species is named in honor of American botanist Andrew Clewell, who with Alwyn Gentry collected the species for the first time. Clewell is a Professor at the University of South Florida. Earlier in his career he spent a lot of time collecting in Central America and Panama and has collected several new species in Araceae.

Habitat and distribution:—*Anthurium clewellii* is endemic to Panama, known only from the type locality on the western slopes of Cerro Pirre, near El Real at 550–1400 m elevation in *Lower montane rain forest* life zone. Although there are records at 550 m elevation, recent studies by Ortiz *et al.* (2019) showed that this species (referred to as *Anthurium* sp. nov. 2) is associated with elfin forests located at elevations above 1000 m. Also, the authors reported only 10 individuals of this species in almost 1 ha sampled, suggesting that *A. clewelii* is a rare species.

Phenology:—Flowering and fruiting in June and July.

Discussion:—This species is a member of sect. *Belolonchium*, where it has been confused with *A. antonianum*, but the latter species differs by having more broadly ovate blades, proportionately broader (2.5 ×) reddish ovate coriaceous spathes and more cylindroid tapered red-purple spadix. Croat (1986b) identified some specimens of *A. clewellii* from the type locality as *A. antonioanum*, probably due to not knowing in detail the reproductive structures. Both species have similar leaves, but the latter differs markedly by the shape and colors of the inflorescence (as mentioned above). Currently *A. antonioanum* is restricted to montane and submontane forests of western Panama. *Anthurium clewellii* is also similar to *A. laevum* Croat & O.Ortiz (species described here), due to the shape of the leaf blade and reddish brown fibrous cataphylls but *A. laevum* differs in having leaf blades with numerous primary lateral veins (up to 18 pairs), a reflexed greenish-purple spathe and a violet spadix.

On Cerro Pirre (type locality), *A. clewellii* compares in size with *A. dukei* Croat (1986b: 87) which also has red berries but that species has ovate-triangular blades which are 1.5 or more times longer than wide, have more primary lateral veins (12–20 pairs) and fewer basal veins (6–8 pairs) with 2–3 pairs free to the base (versus 0–1 free to the

base in *A. clewellii*) and dry pale yellow-brown on the lower blade surfaces not dark brown. In addition, *A. dukei* is surely a member of sect. *Cardiolonchium* despite the fact that it was mistakenly reported as sect. *Belolonchium* in the *Anthurium* treatment for Panama (Croat 1986b).

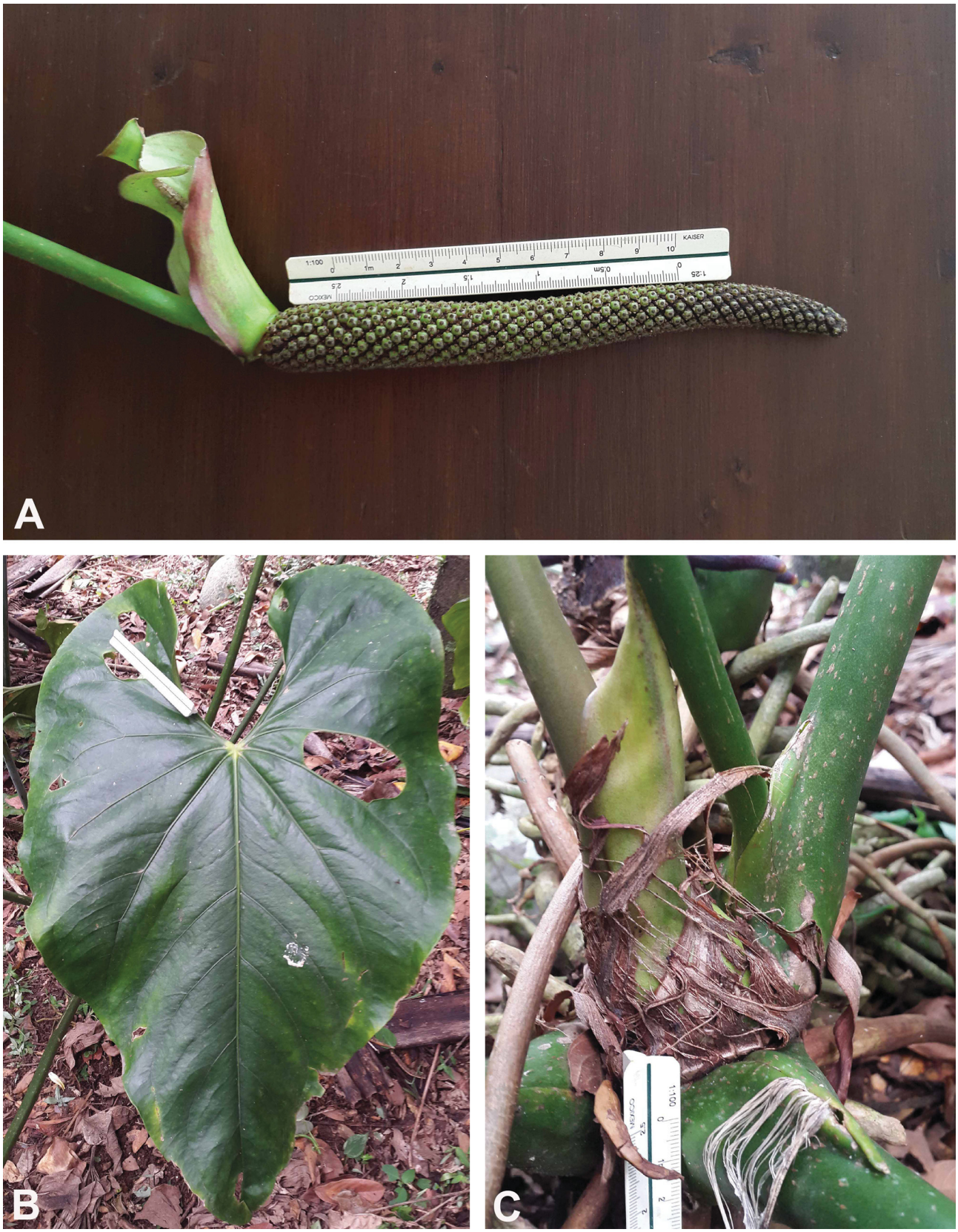

FIGURE 5. *Anthurium castillomontii* Croat: **A**. Infructescence. **B**. Leaf blade (adaxial surface). **C**. Cataphylls. Photo credits: Jay Vannini.

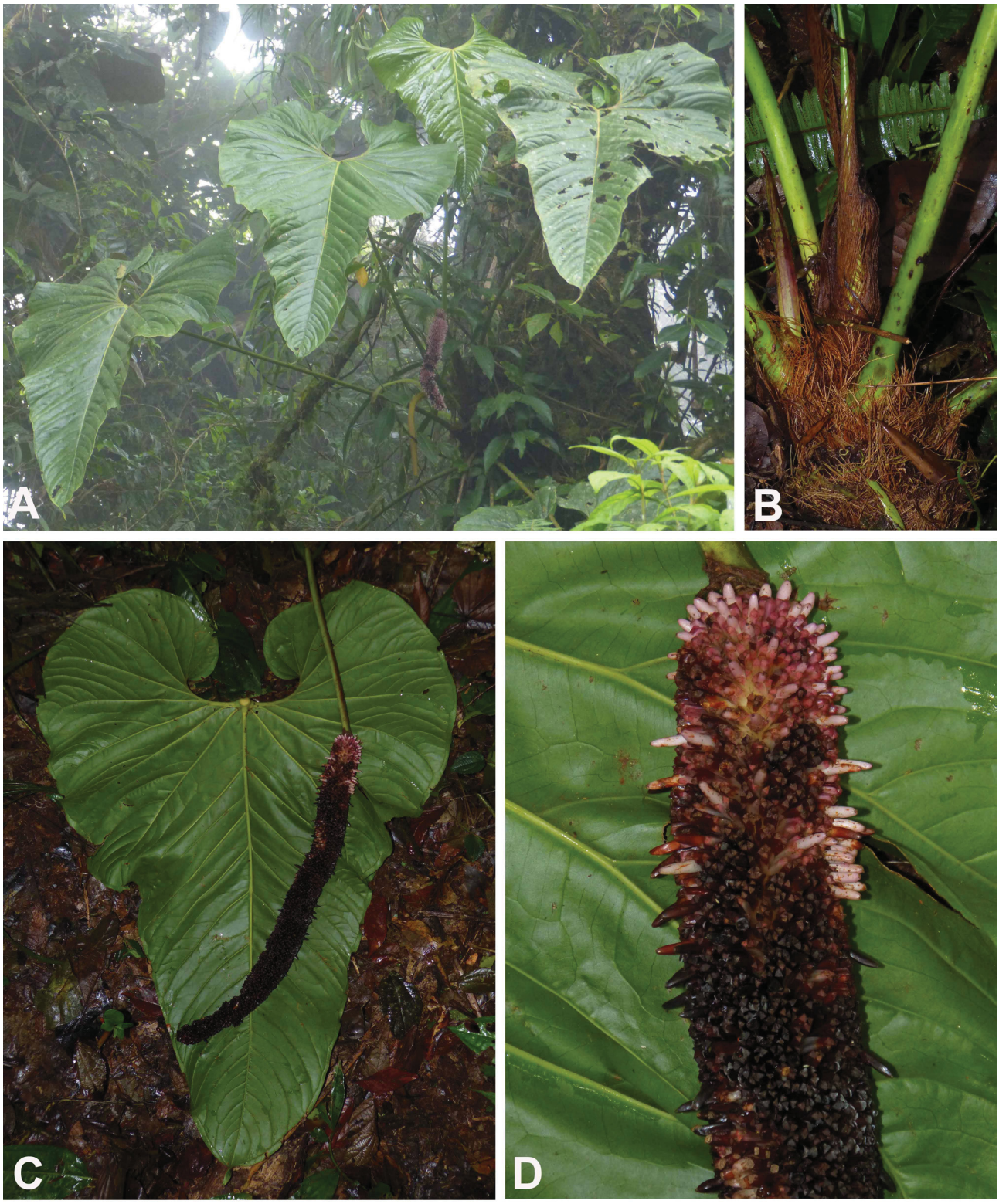

FIGURE 6. *Anthurium clewellii* Croat & O. Ortiz: **A**. Habit. **B**. Cataphylls. **C**. Leaf blade (abaxial surface) and the infructescence. **D**. Berries. Photo credits: Orlando O. Ortiz.

Conservation status:—*Anthurium clewellii* is thus far known only from one location (Cerro Pirre), which is included in the protected area of Darién National Park. This species comprises an extent of occurrence of 7 km^2, an area of occupancy of 12 km^2 and occurs in quite inaccessible areas along mountain peaks, totally away from settlements or disturbed sites. Considering that the natural habitat and populations of this species do not presently suffer anthropic disturbances or potential threats, *A. clewelii* can provisionally be assessed as Least Concern (LC).

Additional specimens examined (paratypes):—PANAMA. Darién; middle slopes on W side of Cerro Pirre,

07°57'N, 77°46'W, 550–760 m, 28 June 1988, *T.B. Croat 68896* (K!, MO!, PMA!, US!); Summit of Cerro Pirre, cloud forest, 07°55'21"N, 77°42'57"W–07°55'40"N, 77°42'12"W, 1000–1400 m, 29 Dec 1972, *A. Gentry & A. Clewell 6994* (MO!).

***Anthurium fortunense* Croat & O.Ortiz*, sp. nov.* (Figs. 7A, 8)**

Anthurium fortunense is characterized by its epiphytic-climbing life form, elongated dark brown-drying internodes, thin, non-fibrous cataphylls which are promptly deciduous or with only fragments remaining; long petiolate leaves, subterete weakly sulcate petiole which dries narrowly sulcate with the dried margins acute near apex, small ovate-elliptic, slightly bicolorous, brownish-drying, prominently acuminate blades with a rather broad but narrowly pointed acumen and a rounded base, a single pair of basal veins, 7–8 pairs of primary lateral veins, a rather remote collective vein and glandular punctations on both surfaces as well as by the long-pedunculate inflorescence with a terete rose-salmon peduncle about twice as long as the petioles, greenish reflexed narrowly lanceolate spathe and the narrowly oblong sessile reddish orange spadix.

Type:—PANAMA. Chiriquí: Distrito Gualaca, Reserva Forestal Fortuna, División Continental, 08°47'11"N, 82°13'03"W, 1236 m, 9 Nov 2013, *O.O. Ortiz, J. Batista & J. Miranda 1821* (holotype PMA!).

Epiphytic-climbing on other vegetation; **internodes** 1.5–3.0 cm long, 4 mm diam., drying dark brown, matte; **cataphylls** 2.5–3.0 cm long, thin, brownish, fragile, lacking obvious fibers, mostly deciduous. Leaves well dispersed on stem; **petioles** 3.3–7.5 cm long**,** 1 mm diam., subterete, weakly sulcate, drying narrowly sulcate with the dried margins acute near apex; **blades** ovate-elliptic, 7.7–10.1 × 3.8–5.0 cm, 2.0–2.5 times longer than wide, broadest near middle or slightly below middle, 1–3 times longer than petioles, broadly acuminate with a long tapered sub-acicular point at apex, acute to subrounded at base, drying brownish and matte above, somewhat paler, more yellowish brown, semi-glossy below; **midrib** convex and concolorous, drying often acute above, narrowly rounded and darker below; **primary lateral veins** 7–8 pairs, arising at 30–40° angle, moderately obscure and weakly raised on both surfaces; **basal veins** 1 pair, forming a collective vein 5 mm from margin; **upper surface** minutely granular, conspicuously dark glandular-punctate; lower surface moderately smooth, sparsely pustular, densely pale granular, more conspicuously dark glandular-punctate than above. **Inflorescence** erect; **peduncle** 15.3 cm long, ca. 1 mm diam., slender, terete, rose-salmon colored; **spathe** narrowly lanceolate green, reflexed, 2.2 × 0.4 cm; **spadix** narrowly oblong, sessile, reddish orange, 4 cm long, 2.5 mm diam.; **flowers** 2 visible per spiral, 2.7–2.8 × 2.5–2.6 mm; tepals coarsely granular; lateral tepals 1.0–1.3 mm wide, inner margin broadly rounded, outer margins 2-sided; stamens not seen. **Berries** not seen.

Eponymy:—The species is named for the type locality in the Reserva Forestal Fortuna.

Habitat and distribution:—*Anthurium fortunense* is endemic to Panama, known only from the Continental Divide between Chiriquí Province and Bocas del Toro Province at 1236 m in a *Premontane rainforest* life zone.

Phenology:—Flowering in November.

Discussion:—*Anthurium fortunense* (sect. *Tetraspermium*) is most similar to *A. tonduzii* Engler (1898: 376) which differs in having leaf blades with 3–6 pairs of primary lateral veins and markedly stipitate spadices with 4–5 flowers visible in the principal spiral and up to 7 flowers visible in the alternate spiral. In the Lucid *Anthurium* key *A. fortunense* tracks to *A. caucanum* Engler (1885: 274) which differs in having much thicker stems (usually 2.5–3.0 cm diam.), fibrous cataphylls and a prominently stipitate spadix; *A. gerherrerae* Croat (in Croat et al. 2009: 53) differing by having a mass of cataphyll fibers and much shorter (1.3–2.5 cm long) petioles; *A. licium* Croat & Oberle (2004: 74), differing by broadly ovate (5–10 cm wide) blades with 2–3 pairs of basal veins; *A. obtusum* (Engler 1898: 357) Grayum (1997: 35) and *A. scandens* (Aublet 1775: 836) Engler (1878: 78) both of which differ by having conspicuous fibrous cataphylls and proportionately shorter, usually greenish spadices.

Conservation status:—Data deficient (DD).

FIGURE 7. Holotype specimens: **A**. *Anthurium fortunense* Croat & O. Ortiz. **B**. *Anthurium hayanum* O. Ortiz & M. Cedeño. **C**. *Anthurium kirkdukeorum* O. Ortiz & Croat. **D**. *Anthurium laevum* Croat & O. Ortiz.

FIGURE 8. *Anthurium fortunense* Croat & O. Ortiz: **A**. Habit. **B**. Stem. **C**. Inflorescence. Photo credits: Orlando O. Ortiz.

Anthurium hayanum O.Ortiz & M.Cedeño, *sp. nov.* (Figs. 7B, 9)

Anthurium hayanum is characterized by its terrestrial life form and short stems; short internodes, semi-intact persistent cataphylls; long petiolate leaves; ovate-subcordate blades, shortly lobed at base with an arcuate to triangular sinus, 5–6 pairs primary lateral veins, 3–4 pairs of basal veins (usually all free to the base), pendent inflorescences, erect, ovate dark-purple spathes and cylindroid to weakly tapered, cream colored spadices with 6–7 flowers per spiral.

Type:—COSTA RICA. Limón: Cantón Talamanca, distrito Telire, Gira Transtalamanca, Fila Bugu, 27 Apr 2017, *M. Cedeño-Fonseca, I. Chinchilla, A. Karremans, G. Rojas & O. Zúñiga 1086* (holotype USJ!).

Terrestrial; stems short; **internodes** short, ca. 1 cm diam.; **cataphylls** semi-intact persistent. Leaves with **petioles** 33.5–41.0 cm long, 3–5 mm diam., terete; geniculum 2.5 cm long, slightly darker than petiole; **blades** ovate-subcordate, shortly lobed at base, 26.5 × 11.0–14.5 cm, acuminate, 2.3 times longer than wide, 0.8 times as long as petiole, moderately thick, green and nearly matte above, drying grayish semi-glossy below, grayish-green matte above; **anterior lobe** 23 cm long, broadly rounded on margins; **posterior lobes** 2.8–3.5 × 4.5–5.5 cm; upper surface smooth; lower surface smooth; **sinus** arcuate to triangular, 2.5 cm deep, 2.5 cm wide; **midrib** narrowly raised below, drying narrowly raised, discolorous below; **primary lateral veins** 5–6 pairs, slightly discolorous below; tertiary veins conspicuous below; **collective veins** arising from one of the primary lateral veins near the medial part of the blade or 1st basal vein; **basal veins** 3–4 pairs, all free to the base (sometimes 3rd and 4th slightly fused for 1 cm); **posterior ribs** usually absent (sometimes weakly developed 1 cm). **Inflorescence** pendent; **peduncle** 14 cm long, terete, dark-purple; **spathe** ovate, erect, 4.0 × 1.2 cm, apiculate, thinly coriaceous, green at base and purple towards the apex in the internal part, dark-purple with violet-purple margins in the external part, drying dark-brown to blackish with numerous short-pale lineations; **spadix** sub-sessile, 2.5–3.0 cm long, 5 mm diam., cylindroid and weakly tapered, cream colored

turning yellowish at apex, drying dark-brown; **flowers** 6–7 per spiral, drying ca. 2 mm wide; lateral tepals ca. 1 mm wide; stamens not exserted. **Berries** not seen.

Eponymy:—The species is named in honor of British botanist Lord Alistair Hay, expert on Asian Araceae and former Director of the Sydney Botanical Garden in Australia. Hay is the world's authority on the tribe Lasioideae (Araceae) and worked extensively in New Guinea. Annually he spends part of his time in Australia and part of his time operating a botanical garden (Paz z Flora) near Bitaco, Colombia.

Habitat and distribution:—*Anthurium hayanum* is endemic to Costa Rica, known only from the type locality in Limón Province in the Cantón Talamanca on the Fila Bugu in a *Premontane wet forest* life zone.

Phenology:—Flowering in April.

Discussion:—*Anthurium hayanum* is tentatively a member of sect. *Calomystrium*. In the Lucid *Anthurium* key the species tracks *to A. coleorrhiza* Croat & Bay (2006: 30), *A. subtriangulare* Engler (1885: 279) and *A. tysonii* Croat (1986b: 193). *Anthurium coleorrhiza* differs from *A. hayanum* in having pale green to white spathes and leaf blades with 8–12 pairs of primary lateral veins; *A. subtriangulare* differs by having leaf blades with more than 8 pairs of primary lateral veins, long-lanceolate spathes and thicker spadices (0.8–1.0 cm diam.), and *A. tysonii* differs in having longer cataphylls (15–24 cm long), greenish spathes and pale green to creamy white spadices.

Anthurium hayanum could also be confused with some species of the section *Pachyneurium* with dark-purple spathes, such as *A. watermaliense* Bailey & Nash (in Bailey 1914: 303) or *A. ratonense* Croat & O.Ortiz, which is another new species described in this paper. Both species differ from *A. hayanum* in having triangular-sagittate blades with prominent posterior lobes and a parabolic to hippocrepiform or deeper spathulate sinus and erect inflorescences with typically reflexed spathes.

Conservation status:—Data deficient (DD).

FIGURE 9. *Anthurium hayanum* O. Ortiz & M. Cedeño: **A**. Habit. **B**. Peduncle and spathe (external surface). **C**. Inflorescence. Photo credits: Marco Cedeño-Fonseca.

Anthurium kirkdukeorum **O.Ortiz & Croat,** ***sp. nov.*** **(Figs. 7C, 10)**

Anthurium kirkdukeorum is characterized by its terrestrial habit, short internodes, cataphylls persisting as fibers, subterete petioles sulcate adaxially, the 3-lobed greenish drying blades, the frequently arcuate sinus and broadly concave lateral margins as well as the short-pedunculate inflorescence with a purplish ovate-lanceolate spathe which is remarkably decurrent on to the peduncle and a markedly stipitate cream to yellowish spadix.

Type:—PANAMA. Chiriquí: Distrito de Gualaca, Reserva Forestal Fortuna, Cerro La Pava, 08°45'08"N, 82°13'23"W, 1290 m, 15 Mar 2014, *O.O. Ortiz, F. Miranda, J. Miranda 2152* (holotype MO!, isotype PMA!).

Terrestrial; usually less than 75 cm tall; **internodes** short, 1.5–2.0 cm diam.; **cataphylls** 7–13 cm long, persisting as mostly pale or brownish fibers. Leaves with **petioles** 22.5–41.0 cm long (average 29.4 cm), 3–5 mm diam., subterete, obtusely sulcate adaxially; **blades** narrowly triangular-hastate to sub-trilobed, 22.5–41.0 × 18.5–38.5 cm (average 29.4 × 24.9 cm), 0.9–1.6 times longer than broad, broadest across the tips of posterior lobes, 0.6–1.1 times as long as petiole, narrowly long-acuminate and down-turned at apex, prominently lobed at base, dark green and weakly glossy above, slight paler and semiglossy below, drying grayish brown to dark brown above, yellowish to grayish brown below; **anterior lobe** 20–41 cm long (average 25 cm), markedly concave along the entire margin and continuously concave along the often markedly spreading **posterior lobes** 8.0–18.5 × 2.7–7.5 cm (average 13.0 × 2.6 cm); **sinus** 1.5–11.5 (average 4.6); **basal veins** (4)5–6 pairs, 1st pair often free to base, sometimes fused 0.5–2.5 cm; 2nd pair fused 1–6 cm; 3rd pair fused 3.8–6 cm; 4th pair fused 4–6 cm; **posterior ribs** moderately curved especially in the distal 2/3, naked 1/2–2/3 its length; **midrib** raised on both surface; **primary lateral veins** 6–9 pairs, arising at 30–45° angle; tertiary veins weakly raised on lower surface. **Inflorescence** erect; **peduncle** 4.3–5.5 cm long; drying 2–3 mm diam.; **spathe** erect, 9.5–14.3 × 1.7–5.0 cm, purple-tinged green to purple; **spadix** white to yellowish or greenish, yellow toward apex, 9.7–11.0 cm long; stipe 3 cm long, 2.2 cm free from spathe. **Berries** yellow.

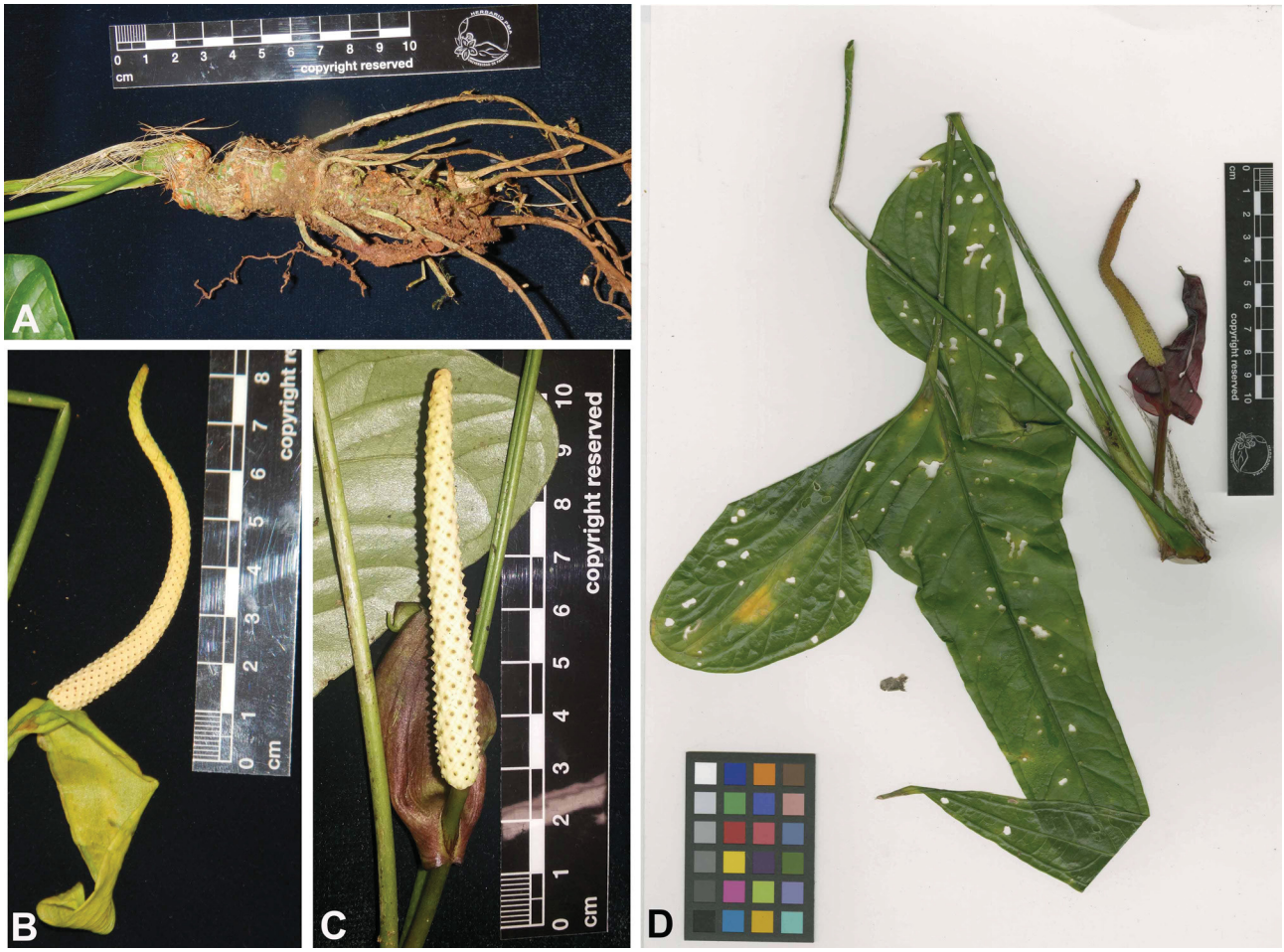

FIGURE 10. *Anthurium kirkdukeorum* O. Ortiz & Croat: **A**. Stem with cataphylls. **B**. Inflorescence (pre-anthesis). **C**. Inflorescence (at anthesis). **D**. Leaf blade and inflorescence. Photo credits: Orlando O. Ortiz.

Eponymy:—The species is named in honor of Joseph Kirkbride Jr. and James Duke who made the first collection of the species on April 20, 1968 on their now famous trek from the Caribbean coast in Almirante to Cerro Punta in Chiriquí Province.

Habitat and distribution:—*Anthurium kirkdukeorum* is endemic to Panama, known only from Chiriquí Province and Bocas del Toro Provinces at 1290 m in a *Tropical wet forest* life zone very near the border with *Premontane rain forest* life zone.

Phenology:—Flowering and fruiting in March.

Discussion:—*Anthurium kirkdukeorum* is an unusual member of sect. *Pachyneurium* (owing to its lack of the typical bird's nest habit of the section). It is most closely related to *A. watermaliense* which differs in having the following characteristics: semi-intact persistent dark-brownish cataphylls, ovate-triangular blades, longer peduncles (more than 10 cm long), dark-purple spathes and usually dark-purple spadices (sometimes whitish).

Conservation status:—This species is thus far known only from one location which is included in the Fortuna Forest Reserve. This protected area includes a functioning dam, but its natural areas are not currently subject to any threats. In the absence of population data, and contingent upon effective protection of the Reserve, *A. kirkdukeorum* can provisionally be assessed as least concern (LC).

Additional specimens examined (paratypes):—PANAMA. Chiriquí: Between Quebrada Hondo and divide on Caldera-Chiriquicito trail, cloud forest, 08°46'N, 82°15'W–08°47'N, 82°15'W, 1700–1900 m, 20 April 1968, *J.H. Kirkbride, Jr. & J.A. Duke 960* (MO!); Reserva Forestal Fortuna, sendero Honda, 08°45'08"N, 82°13'23"W, 1190 m, 15 Mar 2014, *O.O. Ortiz, F. Miranda, J. Miranda 2151* (MO!, PMA!).

Anthurium laevigatum Croat & O.Ortiz, *sp. nov.* (Figs. 11A–B)

Anthurium laevigatum is characterized by its epiphytic life form, large size, short internodes with persistent cataphyll fibers, long more or less quadrangular dark brown-drying petioles which are slightly shorter than the blades, large narrowly ovate-sagittate dark brown-drying abruptly acuminate blades with a hippocrepiform sinus, 11 pairs of basal veins one pair of which is free to the base, a long curving posterior rib most of which is naked to the sinus, up to 18 primary lateral veins, collective veins arising from one of the lower pairs of basal veins and only weakly raised tertiary veins, as well as a long pedunculate inflorescence with a greenish reflexed spathe and long-tapered stipitate reddish violet spadix.

Type:—PANAMA. Darién: primary forest along the headwaters of Río Tuquesa, ca. 2 km air distance from the Continental Divide, vic. of the upper gold mine of Tyler Kittredge, 08°33'N, 77°29'W, ca. 430 m, 25 Aug 1974, *T.B. Croat 27166* (holotype MO!).

Epiphyte at 10 m; **internodes** short; **cataphylls** persistent as red-brown fibers. Leaves with **petioles** 62.6–130.3 cm long, 8–12 mm diam., quadrangular with acute margins, drying dark brown; geniculum 1.9–2.9 cm long, drying darker than petiole; **blades** narrowly ovate-sagittate, 69.2–107.5 × 43.9–65.4 cm (averaging 94 × 58 cm), 1.6 times longer than broad, broadest below petiole attachment, 0.8–1.2 (averaging 1) times long as petioles, abruptly acuminate at apex, (acumen to 1 cm long), prominently lobed at base, drying subcoriaceous, dark brown and matte above, yellowish brown and weakly glossy below, epunctate; upper surface densely papillate at high magnification; lower surface densely pale-speckled at high magnification; **anterior lobe** 58.5–93.3 cm long, with straight to slightly concave margins in the lower half of anterior lobe, the distil margin broadly rounded; **posterior lobes** 22.7–33.7 × 13–25 cm, directed downward and inward; **sinus** hippocrepiform, 10.7–25.7 cm deep, 16.3–27.4 cm wide; **basal veins** 11 pairs, 1st pair free to base, 3rd pair fused to 10.4 cm, 7th and 8th pair fused to 16.6 cm; **posterior ribs** gradually curved, naked 14 cm; **midrib** drying narrowly rounded and paler above, narrowly raised to narrowly acute and darker below; **primary lateral veins** 18 pairs, arising at 60° angle near middle, drying weakly and narrowly rounded, paler above, narrowly acute and paler below; tertiary veins drying prominulous above and below; **collective veins** arising from 3rd pair of basal veins, 3 mm from margin. **Inflorescence** with **peduncle** 40.8–44.8 cm long; **spathe** greenish, reflexed, 11.2–17.7 × 1.5–3.2 cm, oblong-lanceolate, drying moderately coriaceous, reddish dark brown; **spadix** reddish violet, stipitate to 1 cm, long-tapered, 19.5–34.1 cm long, 9–13 mm diam., drying dark brown; **flowers** 10 visible per spiral, drying 2.3 mm long and 1.4 mm wide; tepals minutely granular on drying; lateral tepals 1.7 mm wide, outer margins 2-sided, inner margin broadly rounded; stamens not exserted. **Berries** not seen.

Eponymy:—The species epithet is from the Latin *laevigatus* referring to the smooth leaf blades.

Habitat and distribution:—*Anthurium laevigatum* is endemic to Panama, known only from the type locality in along the Continental Divide in Darién Province at ca. 430 m in a *Premontane wet forest* life zone.

Phenology:—Flowering in August.

FIGURE 11. Holotype specimens: **A–B**. *Anthurium laevigatum* Croat & O. Ortiz. **C**. *Anthurium lucilanum* Croat & O. Ortiz. **D**. *Anthurium macveniae* Croat.

Discussion:—This species is a member of sect. *Belolonchium*. *Anthurium laevigatum* has been confused with *A. brownii* Masters (1876: 744) but that species differs in having a terete petiole, blades with the anterior lobe markedly constricted, collective veins arising from the 1st pair of basal veins or the lower pair of primary lateral veins and very prominently raised tertiary veins. Owing to its more or less quadrangular petiole *Anthurium laevigatum* could perhaps also be confused with *A. cogolloanum* Croat & Mora (in Croat & Finch 2003: 4) from Chocó Department in Colombia but that species has the petioles quadrangular-winged and the collective veins arise from the 4th to 6th pairs of basal veins.

Conservation status:—Data deficient (DD).

Additional specimens examined (paratypes):—PANAMA. Darién: primary forest along the headwaters of Río Tuquesa, ca. 2 km air distance from the Continental Divide, vic. of the upper gold mine of Tyler Kittredge, 08°33'N, 77°29'W, ca. 430 m, 25 Aug 1974, *T.B. Croat 27147* (MO!); upper gold mine of Tyler Kittredge, 08°33'N, 77°29'W, ca. 430 m, 25 Aug 1974, *T.B. Croat 27197* (MO!).

Anthurium laevum Croat & O.Ortiz, *sp. nov.* (Figs. 7D, 12)

Anthurium laevum is characterized by its epiphytic life form, short internodes, subterete obscurely sulcate yellow-brown-drying petioles, ovate-triangular-sagittate, acuminate, brownish-drying blades with parabolic to weakly hippocrepiform sinus with a weakly decurrent petiole, 6–7(8) pairs of basal veins, usually none of them free to the base, collective veins usually arising from the primary lateral veins, weakly raised moderately widely spaced tertiary veins as well as by a long-pedunculate inflorescence, spathe spreading, green on the outside and purple within, flowers with orange pollen.

Type:—PANAMA. Darién: Serranía de Pirre, along steep narrow ridge from Altos de Nique to Cerro Pirre, ca. 8 km due N of Alturas de Nique, ca. 8 km W of Cana Gold Mine, virgin cloud forest, 07°44'N, 77°43'W–07°46'N, 77°44'W, 1430–1480 m, 27 July 1976, *T.B. Croat 37840* (holotype MO!, isotype PMA!).

Epiphyte, 1.7 m tall; stem less than 30 cm long; **internodes** short, to 3 cm diam.; **cataphylls** to 25 cm long, persisting as fine light brown fibers with fragments of darker brown epidermis; **petioles** to 60 cm long, 8 mm diam. midway, subterete, obscurely sulcate, medium green, semiglossy. Leaves with **blades** 34–45 × 24–33 cm, 1.3–1.4 times longer than broad, ovate-triangular-sagittate, acuminate at apex, prominently lobed at base, dark brown and semiglossy above, moderately paler and moderately glossy below; drying drying grayish brown and matte above, yellowish brown and weakly glossy below, conspicuously undulate along margins; **anterior lobe** 28 cm long, straight to broadly concave along margin; **posterior lobes** directed inward or sometimes spreading, moderately spreading 10–12 cm long, **sinus** parabolic to weakly hippocrepiform with a decurrent petiole; **midrib** raised on both surfaces; **primary lateral veins** 5–7 pairs, arising at 25–35° angle near apex, to 55° angle toward base; **basal veins** 6–7(8) pairs, usually with none of them free to the base, 1st pair fused 1.0–1.5 cm, 2nd pair fused to 2–3 cm; 3rd pair fused to 4–5 cm; **posterior ribs** naked along most of its length; **collective veins** usually arising from the primary lateral veins; tertiary veins weakly raised and widely spaced; secondary veins clearly visible on lower side, and moderately widely spaced. **Inflorescence** erect, long-pedunculate; **peduncle** 88 cm long, 7 mm diam. midway, drying light brown; **spathe** 12.0–20.0 × 2.5–3.0 cm, spreading and then reflexed and sometimes curled under at apex, markedly undulate along the margin, green on the outside, purple on the inside or at least along the margins; **spadix** 16 cm long, 8 mm diam., stipitate 1.0–1.5 cm, cylindoid-tapered to long-tapered, purple-violet; **flowers** 6–9 visible per spiral, 2.5–3 mm long; stamens held at the surface of tepals; anther with orange pollen. **Berries** not seen.

Eponymy:—The species epithet is from the Latin *laevis* (meaning smooth) referring to the smooth surface of the leaves of this species.

Habitat and distribution:—*Anthurium laevum* is endemic to Panama, known only from the type locality in Darién Province at 1325–1480 m in a *Lower montane rain forest* life zone.

Phenology:—Flowering in April.

Discussion:—*Anthurium laevum* is a member of sect. *Belolonchium* and was long confused with *A. brownii* which differs by having more slender stems (up to 3 cm diam.), usually shorter petioles, narrowly ovate-triangular leaf blades with a narrow anterior lobe, tertiary veins prominently and closely raised, 4–8 pairs of primary lateral veins, an open sinus (broadly parabolic) and long tapered spadices. Other similar species is *A. laevigatum* which is also described in this work. The last species differs from *A. laevum* by having quadrangular petioles, leaf blades with more than 10 pairs of basal veins and long-tapered spadices with 10 flowers visible in the alternate spiral.

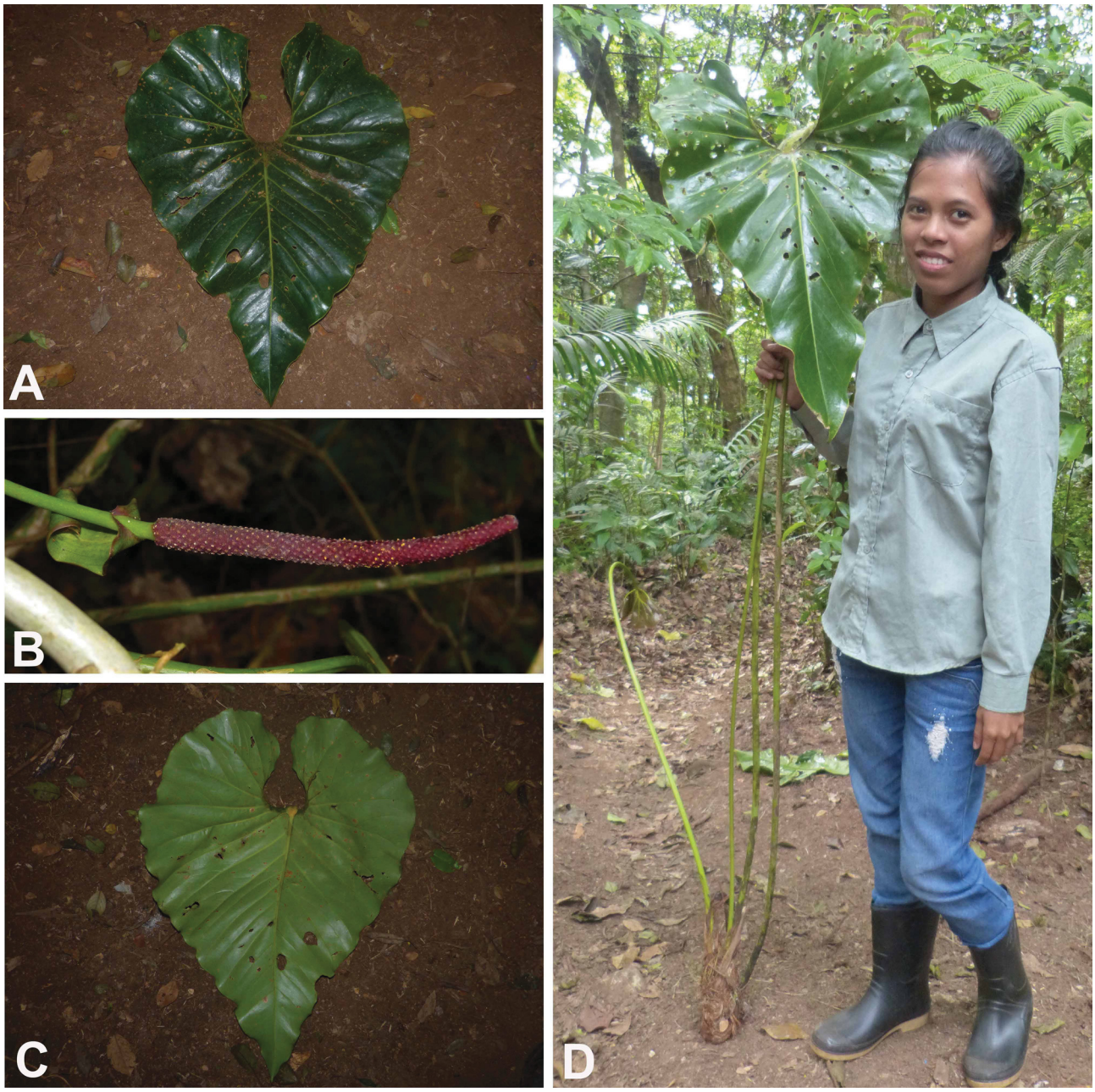

FIGURE 12. *Anthurium laevum* Croat & O. Ortiz: **A**. Leaf blade (adaxial surface). **B**. Inflorescence. **C**. Leaf blade (abaxial surface). **D**. Adult plant size (1.7 m tall). Photo credits: Orlando O. Ortiz.

In the Lucid *Anthurium* key the species tracks to *A. dolichophyllum* Sodiro (1903: 341), which differs by having leaf blades with a narrow anterior lobe and numerous primary lateral veins (more than 20 pairs); *A. striatipes* Sodiro (1902: 81) differing by having leaf blades with more than 15 pairs of primary lateral veins and cucullate spathes; *A. supianum* Engler (1898: 438) differing by having leaf blades with closed rhombic sinus and 4–5 pairs of basal veins.
Conservation status:—This species has an area of occupancy of 8 km^2 and is known from two localities which are included in protected areas (Darién National Park and Chucantí Nature Reserve). However, the areas surrounding the Chucantí reserve are highly exposed to anthropogenic disturbances caused by unsustainable livestock activities. In this locality, this species is extremely rare, it only occurs in elfin cloud forests located on mountain tops. We recommend including *A. laevum* as a critically endangered species, CR B2ab(ii,iii,iv).

Additional specimens examined (paratypes):—PANAMA. Darién: Serranía de Majé, Reserva Privada Chucantí, sendero Los Helicópteros el cual va hacia la cima, 08°47'45" N, 78°27'47" W, 1325 m, 4 Apr 2018, *O.O. Ortiz, M. de Stapf, J. Valdés, V. Jiménez, K. Rodríguez, N. Gálvez, M. Martínez & R. Zambrano 3158* (MO!, PMA!).

***Anthurium lucilanum* Croat & O.Ortiz, *sp. nov.* (Figs. 11C, 13)**

Anthurium lucilanum is characterized by its persistent intact cataphylls, terete petioles, subcoriaceous grayish green-drying blades, moderately bicolorous ovate-cordate abruptly short-acuminate blades which are dark-speckled and short pale-lineate above, and dark punctate and densely granular below with a hippocrepiform sinus, 6–8 pairs of basal veins, the 1st pair of which is free to the base, a curved posterior lobe which is naked for ca. ¾ its length as well as by its moderately broad, oblong-elliptic, greenish to greenish white spathe and cream to white, subcylindroid spadix which is much shorter than the spathe.

Type:—PANAMA. Colón: Parque Nacional Portobelo, Cascajal, Área boscosa a los alrededores de Bajo Bonito, 09°30'41"N, 79°32'38"W, 167 m, 18 Aug 2013, *O.O. Ortiz, L. Martínez, A. Cubilla, J.I. Dojirama & J. Dojirama 1584* (holotype PMA!).

Terrestrial or more commonly epiphytic; **internodes** short, drying 1.5 cm diam.; **cataphylls** 9–30 cm long, persisting intact, medium yellow-brown. Leaves with **petioles** 26–96 cm long, drying 6–8 mm diam., subterete, obtusely and shallowly sulcate adaxially, drying yellow brown to medium-dark brown, weakly ribbed and minutely granular; **blades** ovate-sagittate, 42.0–69.0 × 22.3–43.0 cm, 1.6–2.4 times longer than wide, broadest at ca. 6 cm above petiole plexus, abruptly short-acuminate at apex, deeply lobed at base, subcoriaceous, semiglossy, drying gray-green and semiglossy above, moderately paler and grayish yellow-green, semiglossy below; **anterior lobe** 33.5–54.3 cm long, broadly rounded toward apex but conspicuously concave between midddle 5–9 cm above petiolar plexus, 12–13 cm wide at contricted area, 13.3–17.5 cm wide on anterior lobe in the broadened area above the constriction; **posterior lobes** turned slightly inward, 9.5–20.7 × 10.0–16.3 cm; **sinus** hipocrepiform, 12.5–17.0 cm deep, 4.5–12.3 cm wide; **primary lateral veins** 6–9 pairs, arising at 45–60° angle, convex and concolorous above, narrowly rounded below, drying reddish brown; tertiary veins moderately obscure below; **collective veins** arising from primary lateral veins or 1st pair of basal veins, 4–6 mm from margins; tertiary veins weakly raised on both surfaces; **basal veins** 5–6 pairs, 1st free to base, 2nd free to the base or sometimes fused 1 cm; **posterior ribs** moderately curved, 7.0–9.5 cm long, naked 5–8 cm; **midrib** drying acute and concolorous above, acute and slightly darker below; upper surface dark-speckled and short pale-lineate; lower surface dark-punctate and densely granular below. **Inflorescence** long-pedunculate, erect; **peduncle** 14.5–22 cm long; **spathe** 7.5–17.5 × 2.0–5.5 cm, green to greenish white, oblong-elliptic to somewhat elliptic; **spadix** cream to white, subcylindroid, 8.3–8.7 cm long, 1.1–1.2 cm diam., much shorter than the spathe; **flowers** 10–12 visible per spiral, 2.2 mm long, 2.8 mm wide; tepals densely granular-viscid; lateral tepals 1.1–1.3 mm wide, inner margin broadly rounded, outer margin 2–3-sided. **Infructescence** immature; peduncle to 38 cm long; spathe 23 cm long, 6 cm diam.; spadix to 15 cm long, 1.7 cm diam. **Berries** acutely pointed when immature.

Eponymy:—This species is named in honor of the Panamanian botanist Lucila Guillén who has worked for more than 20 years in the Herbarium of the University of Panama. Lucila has been an important part of the growth and functioning of the PMA herbarium.

Habitat and distribution:—*Anthurium lucilanum* is endemic to Panama, known only from the type locality in Colón and Panama Provinces on the Caribbean slope in Central Panama at 167–800 m in a *Tropical wet forest* and *Premontane wet forest* life zones.

Phenology:—Flowering in March, April, August and October.

Discussion:—*Anthurium lucilanum* (sect. *Calomystrium*) is most closely related to *A. formosum* Schott (1858: 181) and *A. suffusum* Croat & Ortiz (in Ortiz & Croat 2016: 46), which both typically occur at mid-elevation areas above 500 m. *Anthurium formosum* differs from *A. lucilanum* in having brown-drying blades with the collective veins usually arising from one of the lower basal veins and by its typically violet-purple spadix and greenish-white to pale violet spathes; *A. suffusum* differs by having leaf blades with 5 pairs primary lateral veins, creamy white spathes with the inner surface tinged with lavender along the margins and the outer surface pale green and spadices with 7–8 in the alternate spiral.

Conservation status:—This species is known from four localities, three situated in an area highly threatened by livestock activities, but one of them is within a protected area (Chagres National Park). The natural distribution comprises an extent of occurrence of 1254 km^2 and an area of occupancy of 20 km^2. Due to the potential degradation of its habitats, we recommend considering as endangered species [EN B1ab(ii,iii,iv,v)+B2ab(ii,iii,iv,v)].

Additional specimens examined (paratypes):—PANAMA. Colón: Río Guanche, 3–7 km above bridge, 09°29'N, 79°38'W–09°30'N, 79°40'W, 91–213 m, 1 Oct 1978, *B. Hammel, R. Foster & L. McDade 4911* (MO!). Panamá: trail from end of road past Altos de Pacora region of Cerro Jefe and on to Cerro Brewster, 09°17'N, 79°17'W, 600–800 m, 20–25 Apr 1985, *B. Hammel & G. de Nevers 13612* (MO!); El Llano-Cartí Road, 10 km from Interamerican Hwy near El Llano, 09°17'N, 78°51'W, 350 m, 4 Oct 1974, *S. Mori & J. Kallunki 2233* (MO!); El Llano-Cartí Road, Km 16.1,

assoc: *Aspidosperma*, *Attalea allenii*, *Welfia georgii*, 09°18'00"N, 78°58'30"W, 350 m, 10 March 1986, *G. de Nevers et al. 7298* (MO!).

FIGURE 13. *Anthurium lucilanum* Croat & O. Ortiz: **A**. Inflorescence. **B**. Stem and cataphylls. **C**. Habit. Photo credits: Orlando O. Ortiz.

Anthurium macveanae Croat, *sp. nov.* (Fig. 11D)

Anthurium macveanae is characterized by its terrestrial life form, long D-shaped petiole, narrowly ovate-sagittate, gradually acuminate bicolorous blades with a hippocrepiform-subreniform sinus, 4–5 pairs of primary lateral veins and 7 pairs of basal veins, the first pair of which are free to the base, a well-developed posterior rib which is naked for 5.5 cm, collective veins arising from the first pair of basal veins and 1.5–2 cm from the margin as well as a short-pedunculate inflorescence with a greenish yellow boat-shaped, erect-spreading spathe and slightly tapered, short-stipitate purple spadix.

Type:—GUATEMALA. Solola: NE slope of Volcán San Pedro above Lago Atitlán. Forest with alnus, pine, rhamnus, 14°40'20"N 091°16'17"W, 2150 m, 30 Jun 2008, *J. MacDougal & A. MacVean 6209* (holotype MO!).

Terrestrial in forest; **internodes** short. Leaves with **petioles** 1 m long, ca. 1 cm diam., D-shaped and weakly and broadly sulcate, the margins slightly raised, bluntly acute, rounded below, olive-green, matte, drying dark yellow-brown with fine ribs abaxially; geniculum 3.7 cm long, slightly thicker than petiole; **blades** narrowly ovate-sagittate, gradually acuminate, prominently lobed at base, 58.5 × 38.0 cm, 1.5 times longer than broad, 0.6 times as long as the petiole; widest slightly below petiolar plexus, epunctate, drying moderately bicolorous, dark green and semiglossy above, slightly paler and semiglossy below, drying medium gray and weakly glossy above, grayish green and weakly glossy below, the margins sinuate; **anterior lobe** 30 cm long, broadly rounded on margins; **posterior lobes** 14–21 × 21 cm, directed inward; upper surface irregularly areolate-ridged, sparsely short pale-lineate; lower surface faintly parallel-ridged, minutely granular; **sinus** hippocrepiform-subreniform, 18 cm deep, 9 cm wide; **primary lateral veins**

4–5 pairs, departing at 35–60°, narrowly rounded and weakly raised above, narrowly rounded and paler below; tertiary veins weakly raised; **collective veins** arising from 1st pair of basal veins, 1.5–2 cm from margin; **basal veins** 7 pairs, 1st pair free to base, 2nd pair fused for 1.5 cm, 4th & 5th fused for 4.5 cm; **posterior ribs** naked for 5.5 cm; **midrib** drying narrowly and irregularly ribbed and concolorous above, prominently ribbed and paler below. **Inflorescence** with **peduncle** 19 cm long, light yellow-green; **spathe** 14.5 × 3.0 cm, boat-shaped and oblong, erect-spreading, light greenish-yellow tinged with pink adaxially along veins and edges, drying reddish yellow-brown, matte; **spadix** stipitate 6 mm, slightly tapered, purple, 9.8 cm long, 5.5 mm diam.; **flowers** 8 visible per spiral, 2.3–2.5 mm long and wide; tepals matte, faintly pustular; lateral tepals 1.7 mm wide; inner margin broadly rounded, outer margin 2–3-sided. **Berries** not seen.

Eponymy:—The species is named in honor of Ana Lucrecia MacVean, formerly Curator of the Herbarium at the Universidad del Valle (UVAL) in Guatemala, now living in the Pennsylvania and working as a Visiting Scholar at the Herbarium at Pennsylvania State University in State College, Pennsylvania.

Habitat and distribution:—*Anthurium macveanae* is known only from the type locality in Guatemala in the Department of Sololá at 2150 m in a *Premontane wet forest* life zone.

Phenology:—Flowering in June.

Discussion:—*Anthurium macveanae* is tentatively a member of sect. *Andiphilum*, a group restricted to Mexico and adjacent Guatemala. This group was previously considered to be section *Belolonchium* (Croat 1983) but molecular studies by Carlsen and Croat (2019) have shown this Mexican clade to be distinct. The clade is characterized by having short thick internodes, more or less D-shaped petioles, usually orange berries with a pulpy mesocarp. The species is closest to other members of sect. *Andiphilum*, *A. chamulense* Matuda (1956: 339) which differs by having an arcuate sinus; *A. cordatotriangulum* Matuda (1966: 109) differing by having the collective veins arising from the primary lateral veins and *A. yetlense* Matuda (1962: 151) which differs by having a green, more prominently stipitate spadix. *Anthurium macveanae* is closest to *A. nelsonii* Croat (1983: 330) and *A. andicola* Liebmann (1849: 22) from Mexico. *Anthurium nelsonii* differs from *A. macveanae* in having the collective veins arising from one of the primary laterals rather than from the 1st pair of basal veins, having 5 rather than 7 basal veins, an acute to narrowly rounded and apiculate blade apex, and much larger flowers (3.6–4.7 mm long). *Anthurium andicola* differs in having blades with a more open sinus (usually arcuate or rarely hippocrepiform but with the posterior lobes not turned inward) and by having the upper blade surface with etched veins.

Conservation status:—Data deficient (DD).

Anthurium marginervium Croat, *sp. nov.* (Figs. 14A)

Anthurium marginervium is characterized by its terrestrial life form, short internodes, persistent thin cataphylls, terete petioles which dry narrowly sulcate, narrowly ovate, light yellowish, brownish-drying ovate-cordate leaf blades with narrowly V-shaped sinus, 5 pairs of basal veins with 3 pairs free to the base and a very short posterior rib which is naked along its full length, 10–12 pairs of primary lateral veins and collective veins which arise from near the base but run very close along the margin and sometimes almost on the margin, as well as by its moderately short-pedunculate infructescence (peduncle shorter than spadix) with a thin, reflexed, green, moderately broad spathe and a sessile, greenish yellow, cylindroid spadix with early-emergent pistils.

Type:—COSTA RICA. Puntarenas: western slopes of the Cordillera de Talamanca, ca. 1000 m, 23 Aug 1983, *A. Grijalva P., G. Davidse & L.D. Gómez 2941* (holotype MO!).

Epiphyte: **internodes** short; **cataphylls** 14.3–17.0 cm long, thin, drying light brown, the most apical ones decomposing into a few pale fibers with pale brown fragments of epidermis, eventually completely deciduous. Leaves with **petioles** terete, 44.5 cm long, 4 mm diam., drying deeply sulcate, in part with a low medial rib, finely ribbed circumferentially; geniculum 1 cm long, drying darker brown; **blades** narrowly ovate-cordate, abruptly acuminate, 30.2 × 22.3 cm, 1.3 times longer than broad, 0.7 times as long as petioles, dark green, semi-glossy above, paler green, matte below, drying greenish brown and weakly glossy above, yellowish brown and semiglossy below; **anterior lobe** 23.5 × 22.3 cm, broadest at 4 cm above petiolar plexus; **posterior lobes** 7.8 × 8.3–8.5 cm, directed at 155° from the midrib; upper surface drying matte, faintly and sparsely granular; lower surface moderately diffusely and irregularly grayish granular; **sinus** narrow V-shaped, 6.7 cm deep, less than 1 cm wide when flattened; **primary lateral veins** 10–12 pairs, arising 60°, bluntly acute and weakly paler above, narrowly round-raised and sometimes bluntly acute, below; **collective veins** arising from lower basal veins, generally marginal or less than 1 mm from margin; **basal veins** 5 pairs, 1st –3rd pairs free to base, 4th pair fused 0.9 cm; **posterior ribs** less than 1 cm long, naked throughout their length; tertiary veins very

FIGURE 14. Holotype specimens: **A**. *Anthurium marginervium* Croat. **B**. *Anthurium mausethii* Croat, O. Ortiz & R. Hormell. **C–D**. *Anthurium ngabebuglense* Croat & O. Ortiz.

weakly raised and rounded below; **midrib** bluntly acute and concolorous above, narrowly round-raised and bluntly 3-ribbed, concolorous below. **Inflorescence** with **peduncle** 21.1 cm long, terete, drying 6 mm diam.; **spathe** green, to 1.5 cm wide (mostly lost) thin, reflexed, drying matte, granular-pustular, short pale-lineate along the margins above, matte, densely granular, up to 10-veined below; **spadix** sessile, greenish-yellow, 25.6 cm long, 1.9 cm diam.; **flowers** 8–10 visible per spiral, ca. 4 mm long and wide; tepals drying light brown, granular-ridged, lateral tepals 1.4–1.6 mm wide, inner edge rounded, outer margin 2-sided; stamens held just above the level of tepals on slender filaments; anthers drying light brown, 0.6 × 0.4 mm, thecae scarcely divaricate; pistils early-emergent. **Berries** not seen.

Eponymy:—The species epithet is from the Latin "*marginem*" (margin) and "*nervus*" (veins) referring to the close proximity of the collective veins along the margin of the leaf blades.

Habitat and distribution:—*Anthurium marginervium* is endemic to Costa Rica (but to be expected in adjacent Panama), known only from the type locality in Puntarenas Province on the western slopes of the Cordillera de Talamanca above at 1000–1500 m in what is probably a *Premontane rain forest* or *Lower montane rain forest* life zone.

Phenology:—Flowering in August.

Discussion:—*Anthurium marginervium* (sect. *Cardiolonchium)* is seemingly closest to *A. caperatum* Croat & Baker (1979: 32), but that species differs in having cataphylls deciduous or persisting as fine fibers, larger prominently acuminate blades (46–120 cm long) which dry grayish green and glossier on the lower surface with more prominently raised tertiary veins with conspicuous granules in the areoles and spadices with 12–15 flowers visible in the principal spiral and 17–19 flowers visible in the alternate spiral.

In the Central American *Anthurium* treatment (Croat 1986b) the species keys to *A. coloradense* which differs in having cataphylls persisting as coarse short fibers, much larger blades (63 cm long, 46 cm wide) which dry gray-green and semiglossy on the lower surface and a stipitate more long-tapered spadix.

Conservation status:—Data deficient (DD).

Anthurium mausethii Croat, O.Ortiz & R.Hormell, *sp. nov.* (Fig. 14B)

Anthurium mausethii is characterized by its epiphytic life form, short slender stem with short internodes, subterete slightly sulcate petioles subequalling the blades in length , narrowly ovate, weakly cordate-sagittate, light green-drying blades with a V-shaped or narrowly parabolic sinus, a single pair of free basal veins, a weak to non-existent posterior rib which is only weakly or not at all naked along its margin, as well as by the moderately short-pedunculate inflorescence, greenish cream spathe and purple slightly tapered spadix.

Type:—PANAMA. Darién: Along path on ascending ridge to Cerro Pirre from Pijivasal, nearly vertical ascent from Rancho Frio (600 m) to ridgetop grade running to 'Rancho Plástico' (1100 m), 30 June 1980, *J.P. Folsom & J.D. Mauseth 8545* (holotype MO!).

Epiphyte, **internodes** short, 1.3–1.6 cm; **cataphylls** 3.6 cm long, drying dark brown, persistent. Leaves with **petioles** subterete, slightly flattened, weakly sulcate, 15.3–20.3 cm long, 2–3 mm diam.; geniculum 1.8 cm long, drying gray-green; **blades** narrowly ovate, weakly cordate-sagittate, gradually acuminate, 18.4–20.9 × 6.8–10.0 cm, 2.1–2.7 times longer than broad, 1–1.2 times longer than petioles, dark green, matte to weakly glossy above, paler green, matte below, drying greenish-brown above, pale green below; **anterior lobe** 16.4–16.7 × 6.8–8.6 cm, broadly rounded to nearly straight on margins, broadest at mid-point of anterior lobe or half-way down posterior lobes; **posterior lobes** 2.6–5.6 × 2.5–4.3 cm, directed at 143–146° from the midrib; **sinus** V-shaped to parabolic, 2.0–4.2 cm deep, 1.2–3.2 cm wide midway; **midrib** drying acute, moderately raised above, broadly rounded, moderately raised below; **primary lateral veins** 4–5 pairs, arising at 42–49°, weakly raised on both surfaces; **basal veins** 3–4 pairs, 1st pair free to base, 2nd pair free to base or fused 6 mm, 3rd pair fused 1.4 cm; **posterior ribs** 0.8–1.9 cm long, naked 3–6 mm; tertiary veins very weakly raised above, very weakly raised below; **collective veins** arising from upper primary veins, running 2–3 mm from margin; upper surface minutely aereolate-granular at high magnification, lower surface weakly granular, sparsely short-pale-lineate, semiglossy on magnification. **Inflorescence** with **peduncle** green, 8.8 cm long, drying 2 mm diam.; **spathe** greenish-cream, erect-spreading, 4.3 × 0.6 cm; **spadix** sessile, slightly tapered, purple, 4.3 cm long, 0.3 cm diam.; **flowers** 4–5 visible per spiral, 1.4 × 1.3 mm; tepals drying light brown, granular, 0.7 mm wide, inner edge rounded, outer margin 2-sided. **Berries** not seen.

Eponymy:—The species is named in honor of J. D. Mauseth who, along with Jim Folsom collected the type specimen. Mauseth was then a graduate student at the University of Texas in Austin where he now works as a professor in the Department of Integrative Biology and studies evolution of morphogenic mechanisms and structures using cacti as model organisms.

Habitat and distribution:—*Anthurium mausethii* is endemic to Panama and known only from the type locality in Darién Province at 600–1100 m in *Premontane rain forest* and *Tropical wet forest* life zones.

Phenology:—Flowering in June.

Discussion:—The species is a member of sect. *Cardiolonchium*. In this section, *A. mausethii* is similar to *A. chorranum* Croat (1986b: 49) which differs in having much longer blades (45–49 cm long) with narrower, more spreading posterior lobes as well as a green spadix. Also, *A. mausethii* is very similar to the sympatric *A. rotundistigmatum* Croat (1986b: 330), but this species has more robust stems (more than 1.5 cm wide), blades with a widely parabolic to spathulate sinus, 5–7 pairs of basal veins and spadices with more than 7 flowers visible per spiral.

Conservation status:—*Anthurium mausethii* is thus far known only from Darién National Park (Cerro Pirre). This species comprises an area of occupancy of 4 km^2 and occurs in inaccessible areas, totally away from settlements. In the absence of population data and information about its potential threats, *A. mausethii* can provisionally be assessed as data deficient (DD).

Anthurium ngabebuglense Croat & O.Ortiz, *sp. nov.* (Figs. 14C–D, 15A–C)

Anthurium ngabebuglense is characterized by its terrestrial habit, short stem, short internodes, densely arranged roots, long-petiolate leaves, prominently 5-angled petioles, oblong-elliptic-oblancelate and cordate blades with 8 pairs of basal veins, 4 pairs of which are free the base, a short posterior rib which is scarcely at all naked, 45 pairs of primary lateral veins, collective veins arising from the 1st pair of basal veins, grayish brown upper blade surfaces and yellowish brown lower surfaces as well as by the thick broad greenish red spathe and the long-tapered spadix with long-protruding green pistils.

Type:—PANAMA. Bocas del Toro (currently Comarca Ngäbe-Buglé): Región of Cerro Colorado on trail along quebrada ca. 7.5 miles from Chami Camp, ca. 08°35'N, 81°45'W, 1220–1250 m, 13 April 1986, *G. McPherson 8853* (holotype MO!).

Terrestrial; **stem** short, stout and massive; **internodes** very short, to about 3 cm diam.; roots dense and closely contiguous; **cataphylls** not seen. Leaves with **petioles** 83 cm long, ca. 2 cm diam., 5-angular and subquadrangular in cross-section, broadly and sharply sulcate adaxially, prominently 3-ribbed adaxially, drying greenish yellow, weakly glossy; geniculum 3.5 cm long, shaped like petiole; **blades** oblong-elliptic-oblanceolate and subcordate, 155 × 52 cm, 2.9 times broader than long, broadest above the middle, gradually acuminate at apex, prominently cordate at base semi-glossy on both surfaces; **basal veins** 8 pairs, 4 pairs of which are free the base, 5th pair fused 8–10 mm; 6th and higher pairs fused 1.0–2.5 cm; **posterior ribs** short and scarcely at all naked; **midrib** acute and concolorous above, trapezoidal and paler, multiribbed below; **primary lateral veins** 45 pairs, those in the lower part of the blade departing a an angle greater than 90°, prominently turned toward the base, the remainder arising at an acute angle and spreading at 45–50° angle, all of the primary lateral veins narrow raised, acute and concolous above, bluntly acute and paler below; **sinus** narrowly parabolic; **collective veins** arising from the 1st pair of basal veins, 2–5 mm from margin and prominently loop-connecting primary lateral veins, tertiary veins weakly prominulous on both surfaces, concolorous; upper surface drying grayish brown, matte; lower surface drying greenish yellow-brown, semiglossy. **Inflorescence** erect; **peduncle** to 36 cm long; **spathe** reflexed, narrowly ovate-lanceolate, 21.0 × 6.3 cm, coriaceous, greenish red, drying moderately dark brown with prominently raised close ribs; **spadix** long-tapered, sessile, 51.5 cm long, drying 3 cm diam., green in early fruit with long-tapered prominently protruding green pistils; pistils protruding to 5 mm above tepals; **flowers** 9–14 visible per spiral; tepals soon prominently turned upward against the pistils; lateral tepals 1.0–1.4 mm diam., inner margins rounded, eventually turned up prominently against the pistil, outer margin 3–4-sided; pistils early-emergent; stamens held at level of tepals; anthers ca. 1 × 1 mm; thecae scarcely divaricate. **Berries** not seen.

Eponymy:—The species is named for the type locality in the Comarca Ngäbe-Buglé in west central Panama, an area that was previously part of Bocas de Toro Province.

Habitat and distribution:—*Anthurium ngabebuglense* is endemic to Panama and known only from the type locality in Comarca Ngäbe-Buglé at 1220–1250 m in a *Lower montane rainforest* life zone.

Phenology:—Flowering in April.

Discussion:—*Anthurium ngabebuglense* is a member of sect. *Pachyneurium* and is seemingly most closely related to *A. ranchoanum* Engler (1898: 421), which differs by having 4–6 pairs of basal veins and only 4–9 primary lateral veins versus 45 pairs for *A. ngabebuglense*. Other species with similar characters include *A. nervatum* Croat (1986b: 141) that differs by having only 3–5 pairs of basal veins and 19–45 pairs of primary lateral veins and *A. colonicum* Krause (in Engler & Krause 1916: 123), differing by having 2–4 pairs of basal veins and 13–17 pairs of primary lateral veins.

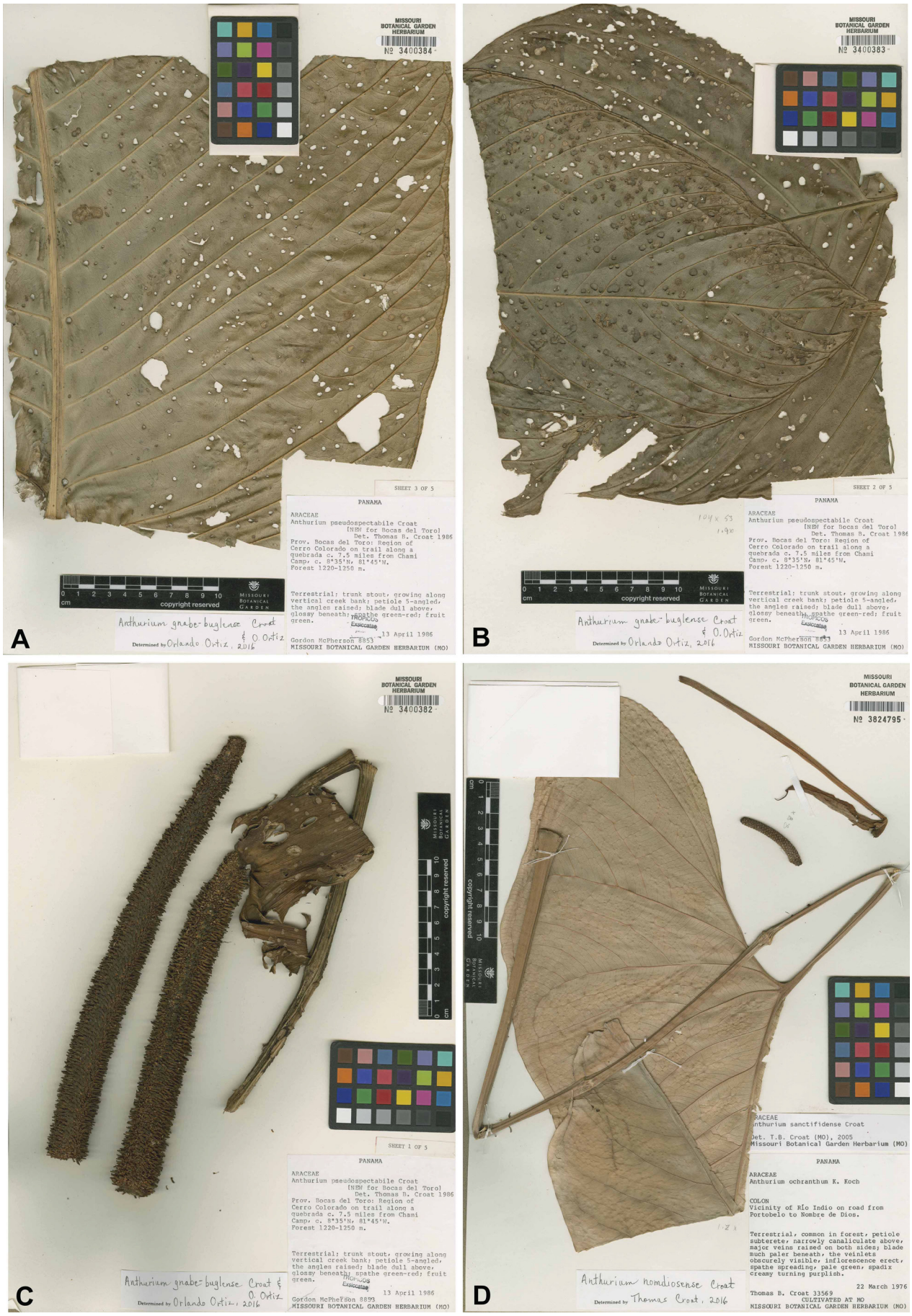

FIGURE 15. Holotype specimens: **A–C**. *Anthurium ngabebuglense* Croat & O. Ortiz. **D**. *Anthurium nomdiosense* Croat & O. Ortiz.

Conservation status:—Currently, the type locality of this species is severely affected by unsustainable agricultural and livestock activities. Given its restricted natural distribution (area of occupancy: 4 km^2) and the continuous threat of its habitats, we strongly recommend considering *A. ngabebuglense* under the category of critically endangered species [CR B1ab(ii,iii,iv,v)+B2ab(ii,iii,iv,v)].

***Anthurium nomdiosense* Croat & O.Ortiz*, sp. nov.* (Figure 15D)**

Anthurium nomdiosense is characterized by its terrestrial life form, short internodes, intact persistent cataphylls, subterete narrowly sulcate petioles, narrowly ovate-sagittate brownish-drying blades with a parabolic sinus, nearly straight posterior rib that is naked throughout most of its length, 6 pairs of basal veins, the 1st pair of which is free to the base, the remainder evenly spaced along the posterior rib, upper surface faintly and densely pale short-lineate, neither surface dark-punctate, as well as by the moderately short-pedunculate inflorescence with a green, spreading, long-apiculate spathe and the short, cream-colored, weakly tapered spadix.

Type:—PANAMA. Colón: Vicinity of Río Indio on road from Portobelo to Nombre de Dios, 22 March 1976, *T.B. Croat 33569A* (holotype MO!).

Terrestrial; stems short; **internodes** short, 2.5 cm diam.; **cataphylls** intact persistent. Leaves with **petioles** 63.5 cm long, 9 mm diam. near base tapering to 5 mm diam. near apex, subterete, narrowly sulcate adaxially, drying light brown, matte, moderately deeply sulcate with the margins bluntly acute; geniculum 2 cm long, very slightly darker than petiole; **blades** narrowly ovate-sagittate, prominently lobed at base, 46 × 37 cm, widest at or slightly below petiolar plexus, abruptly acuminate, 1.2 times longer than wide, 0.7 times as long as petiole, thinly coriaceous, dark green and nearly matte above, moderately much paler and semiglossy below, drying grayish brown and matte above, grayish yellow-brown and semiglossy below; **anterior lobe** 31 cm long, margin mostly convex but with a shallow concave area midway on the anterior lobe; **posterior lobes** 22 × 12 cm, directed slightly outward; upper surface smooth, faintly and densely pale short-lineate; lower surface faintly and densely pale short-lineate, faintly brownish-speckled; **sinus** broadly parabolic, 15 cm deep, 10 cm wide midway; **midrib** bluntly acute becoming narrowly raised toward apex, narrowly raised and several-ribbed below, drying narrowly raised, concolorous above, round-raised, concolorous below; **primary lateral veins** 7–8 pairs, arising at a more acute angle then spreading at 40–55° angle, drying weakly raised, narrowly rouned, concolorous above, narrowly rounded, slightly darker below; tertiary veins obscurely visible above, somewhat more prominent below; **collective veins** arising from one of the pairs primary lateral veins near the apex; antimarginal veins present; **basal veins** 6 pairs, the 1st pair of which are free to the base, 2nd pair fused to 2 cm, 3rd pair to 4 cm, 4th pair to 7 cm, 5th and 6th fused to 7.5 cm; **posterior ribs** arcuate, weakly curved throughout, 7.7 cm long, naked for 7 cm. **Inflorescence** erect; **peduncle** 16.5 cm long, subterete, drying narrowly sulcate, mid reddish brown, matte; **spathe** linear-lanceolate, spreading, 8.5 × 1.2 cm, long-apiculate, thinly coriaceous, pale green, drying reddish brown; **spadix** sessile, drying 5.5 cm long, 7 mm diam., cylindroid and weakly tapered, cream colored turning purplish, drying medium dark brown; **flowers** 5–6 per spiral, drying 1.8 × 1.7 mm; tepals minutely granular on drying; lateral tepals 1.2 mm wide, outer margins 2-sided, inner margin rounded; stamens not exserted. **Berries** not seen.

Eponymy:—The species is named for the type locality near the town of Nombre de Dios in Colón Province.

Habitat and distribution:—*Anthurium nomdiosense* is endemic to Panama, known only from the type locality in Panamá Province at about 50 m elevation in a *Tropical wet forest* and *Premontane wet forest* life zones.

Phenology:—Flowering in March.

Discussion:—*Anthurium nomdiosense* is a member of sect. *Calomystrium*. The type specimen was based on a mixed collection, part of which was *A. ochranthum* Koch (1853: 6) (sect. *Cardiolonchium*). That specimen was correctly treated as such in the revision of *Anthurium* of Panama (Croat 1986). The other part of the mixed collection was initially confused with *A. sanctifidense* Croat (1981: 334). *Anthurium ochranthum* differs from *A. nomdiosense* in having leaf blades narrower and more elongated, lacking pale short lineations on the upper surface and darkish speckling on the lower surfaces. *Anthurium sanctifidense* differs by having the collective veins arising from the 1st pair of basal veins or one of the primary lateral veins, the lower blade surfaces are densely dark-speckled and the spathes broader (2.8–3.4 cm wide), ovate to lanceolate or oblong-elliptic.

Conservation status:—This species comprises an area of occupancy of 4 km^2 and occurs in the outer limits of the Portobelo National Park, near disturbed areas that include urban constructions, agricultural (banana cultivation) and livestock activities. These activities are constantly putting pressure on the remaining natural areas which this species occupies and we therefore suggest considering this species as critically endangered [CR B1ab(ii,iii,iv,v)+B2ab(ii,iii,iv ,v)].

***Anthurium novencidoanum* O.Ortiz & Croat, *sp. nov.* (Fig. 16A)**

Anthurium novencidoanum is characterized by its epiphytic life form, moderately short, slender internodes, deciduous cataphylls, long-petiolate leaves, terete to slightly flattened petioles, greenish, narrowly ovate-lanceolate gradually long-acuminate leaf blades with rounded to weakly subcordate leaf bases with 2–4 pairs of free basal veins, 14–16 primary lateral veins, collective veins arising from the uppermost basal veins, as well as by the long-pedunculate inflorescence with a linear-lanceolate spreading green spathe and long-tapered red inflorescence.

Type:—PANAMA. Darién: Ridgetop area N of Cerro Pirre, between summit of Cerro Pirre and Rancho Plástico; 1200–1400 m, 14 Nov 1977, *J.P. Folsom, J. Contreras & Brijilio 6288* (holotype MO!).

Epiphytic herb; **internodes** 4–10 mm long, mostly slightly longer than broad or about as long as broad, drying 6–8 mm diam.; **cataphylls** ca. 10 cm long, very narrow, soon deciduous. Leaves long-petiolate; **petioles** 37–59 cm long; **blades** narrowly ovate-lanceolate, 38.3–61.6 × 16.0–25.0 cm (averaging 51.9 × 20 cm), 2.2–3.4 times longer than wide, broadest in lower 1/3, 0.9–2.3 times longer than petioles, gradually long-acuminate at apex, narrowly rounded to subcordate at base; **posterior lobes** very short when present, **sinus** (0–)1.7–3.0 cm deep; **basal veins** 2–4 pairs free to the base; **midrib** convex, weakly ribbed and paler above, round-raised, paler and weakly granular below; **primary lateral veins** 14–16 pairs, arising at steep angle then spreading at 50–55° angle, narrowly rounded and concolorous above, round-raised and slightly paler below; tertiary veins moderately raised on lower surface; upper surface moderately smooth, minutely and densely granular on magnification; lower surface sparsely granular granular-lumpy on magnification. **Inflorescence** erect-spreading; **peduncle** 40.5–69.0 cm long; **spathe** 12.0–14.5 × 1.2–2.3 cm, drying dark brown; **spadix** 13.5 cm long, 3–4 mm diam.; flowers 5–6 in principal spiral, 4 in alternate spiral, 3.4 × 2.4 mm; tepals drying dark, minutely granular; lateral tepals 1.4–1.6 mm wide, outer margin broadly rounded on inner margin, 2-sided on outside margins. **Infructescence** with berries developing in lower half of spadix; **berries** drying 4–5 mm diam., style 0.6 mm long, 0.4 mm long with a deep oval pore.

Eponymy:—This species is named in honor of the Panamanian botanist Novencido Escobar, known for being one of the founders of the School of Biology at the University of Panama. Novencido was for many years a professor of systematic botany and he was noted for completing many pioneering floristic studies in Panama and for his studies on the toxic flora and economic botany. Novencido passed away in 1995, but has certainly left a great legacy.

Habitat and distribution:—*Anthurium novencidoanum* is endemic to Panama, known only from Darién Province on Cerro Pirre at 1100–1200 m in a *Tropical rain forest* life zone.

Phenology:—Flowering in November.

Discussion:—The species is a member of the *Anthurium cuspidatum* complex from sect. *Polyneurium* (Croat & Ortiz 2016), closest to *A. talamancae* Engler (1898: 386) and *A. palosecense* Croat & Ortiz (2016: 175) all of which have similar blade shapes. *Anthurium talamancae* differs from *A. novencidoanum* in having 3–5 pairs of basal veins usually with the 1st pair & 2nd pairs fused 0.5–1.5 cm and 3rd & 4th pair of basal veins fused 0.5– 2.0 cm; *A. palosecense* differs in having typically narrower blades (5.7–7.3 cm wide) with fewer pairs of primary lateral veins (6–7 pairs) and 1–2 pairs of basal veins. At the type locality, *A. novencidoanum* can be confused with *A. cerropirrense* Croat (1986b: 47), but the latter species differs in having lanceolate to narrowly elliptic and narrower blades (5.5–13.0 cm wide) and spadices with 7–10 flowers visible in the alternate spiral.

Conservation status:—*Anthurium novencidoanum* is thus far known only from Darién National Park (Cerro Pirre). This species comprises an extent of occurrence of 5 km^2, an area of occupancy of 16 km^2 and occurs in inaccessible areas, totally away from settlements or disturbed sites. In the absence of robust population data and information about its potential threats, *A. novencidoanum* can provisionally be assessed as data deficient (DD).

Additional specimens examined (paratypes):—PANAMA. Darién: Cerro Pirre, ridge top near Rancho Plástico, 07°57'N 77°42'W, 1200 m, 10-20 1977, *J.P. Folsom 4229* (MO!): Serranía de Pirre, end of range, 2–3 miles N of Cerro Pirre, 07°56'N, 77°42'W; 1000–1100 m, 30 Dec 1978, *R.L. Hartman 8497* (MO!).

FIGURE 16. Holotype specimens: **A**. *Anthurium novencidoanum* O. Ortiz & Croat. **B**. *Anthurium orlandoi* Croat. **C**. *Anthurium orlando-ortizii* Croat. D. *Anthurium picadoae* O. Ortiz & Croat.

***Anthurium orlandoi* Croat, *sp. nov.* (Figs. 16B, 17)**

Anthurium orlandoi is characterized by its epiphytic life form, short thick internodes, persisting intact cataphylls, long narrowly sulcate subterete petioles, deeply 3-lobed falcate brown-drying blades with a long-acuminate medial lobe and slender bluntly tipped lateral lobes with the lower margin ending narrowly acute and not markedly unequal as well as by the long-pedunculate inflorescences, erect green moderately coriaceous spathe and cream-colored cylindroid-tapered spadix.

Type:—PANAMA. Veraguas: Cascada de Alto de Piedra, 08°30'54"N, 81°07'11"W, 899 m, 25 Feb 2012, *O.O. Ortiz & R. Chávez 517* (holotype PMA!, isotype SCZ!).

Epiphytic on fallen tree; **internodes** 1–2 cm long, 2–3 cm diam.; **cataphylls** 19–22 cm long, coriaceous, persisting intact. Leaves with **petioles** 70.0–83.5 cm long, 8 mm diam. midway, 6 mm diam. near apex, 1.1–2.2 times longer than blades, drying medium-dark brown, weakly glossy; geniculum 2.5 cm diam, drying darker; **blades** deeply 3-lobed, 41.5–62.0 × 18.5–25.0 cm, 2.2–2.5 times longer than wide, obtuse to subrounded at base, 0.5–0.9 times as long as petioles, drying dark brown and matte above, moderately paler, reddish brown and semiglossy and usually conspicuously pustular, minutely and faintly reddish brown speckled below; **medial lobe** 41.5–81.0 × 6.4–8.5 cm, narrowly long-acuminate, 6.3–9.5 times longer than wide, long-acuminate at apex; **lateral lobes** erect, falcate, 28.5–37.7 × 6.3–7.0 cm, 4.5–5.7 times longer than wide, narrowly rounded at apex, somewhat inequilateral, 3.0–1.2 cm wider on one side, the medial lobe and lateral lobes narrowly confluent with one another, the confluent area 4.5–5.2 cm from the petiolar plexus; **primary lateral veins** 18–25 pairs, arising at 40–50° angle; **collective veins** arising from the lower primary lateral veins on the medial lobe, moderately loop-connected, 4–7 mm from the margins, scarcely raised above, weakly raised below. **Inflorescence** erect; **peduncle** 33 cm long, slightly narrower than petioles, drying dark brown; **spathe** oblong-elliptic, narrowly acuminate, green, 14.8 × 2.5–2.7 cm, erect-spreading; **spadix** narrowly cylindroid, weakly tapered, cream-colored, 14.5–15.0 cm long, 1.0–1.3 cm diam.; **flowers** 5–6 visible per spiral, 2.6 mm long, 2.5–2.6 mm long and wide; lateral tepals 1.5–1.6 mm wide, inner margin rounded, outer margin 3-sided to subrounded; stamens held at level of tepals, 0.4 × 0.3 mm; thecae narrowly ovoid, weakly divaricate. **Berries** not seen.

Eponymy:—The species is named for Panamanian botanist Orlando Ortiz who collected the type specimen. Ortiz is one of the principle field oriented biologists in Central America who are working primarily with Araceae. This name was exclusively proposed by the second author of this work, Thomas B. Croat, who considered using it at the time of its discovery.

Habitat and distribution:—*Anthurium orlandoi* is endemic to Panama, known only from the type locality in Veraguas Province at 450–899 m in *Premontane rain forest* and *Lower montane wet forest* life zones.

Phenology:—Flowering in February and August.

Discussion:—*Anthurium orlandoi* is an unusual member of sect. *Calomystrium* (owing to its deeply 3-lobed leaves) and is most similar to *A. madisonianum* Croat (1986b: 132) which differs by having thinner blades drying typically more light brown to grayish and typically have more broadly falcate lateral lobes, with basal veins branching from near the base and forming several deeply sunken veins which arise at a steep angle and extend toward the apex, as well as by leaf surfaces which are short-pale-lineate on the upper surface and densely darkish-speckled on the lower surface. In addition, it has a red-violet spadix. In contrast, *A. orlandoi* has more coriaceous dark brown-drying blades with the lateral lobes directed nearly straight forward, lacking short pale lineations and instead sparsely granular, and has a creamy-white spadix.

Another 3-lobed species from Costa Rica and Panama, *A. tilaranense* Standley (1927: 245), differs by having its lateral lobes more slender and more widely spreading and typically proportionately much shorter than the medial lobe, usually short pale-lineate on the upper blade surfaces and reddish-epunctate on the lower surfaces, with a spadix that is ivory to white and typically more short-cylindroid.

Conservation status:—This species occurs in three locations within protected areas and comprises an extent of occurrence of 118 km^2 and an area of occupancy of 12 km^2. In the absence of population data and information about its potential threats, *A. orlandoi* can be assessed as data deficient (DD).

Additional specimens examined (paratypes):—PANAMA. Veraguas: Valley of Río dos Bocas along road between Alto de Piedra and Calovebora, 15.6 km NW of Santa Fe, steep forested hill E of river, 450–550 m, 31 Aug 1974, *T. B. Croat 27599* (MO!); N. of Santa Fe, ca. 2 km N of Escuela Agricola Alto de Piedra, 17 Oct 1974, *S. Mori & J. Kallunki 2589* (MO!); 7 km W of Santa Fe on road past agricultural school, along Quebrada Mulabá, a rocky tributary of Río Santa María, 08°31'26"N, 81°07'46"W, 884 m, 13 April 1974, *M.H. Nee 11226* (MO!); 3 mi. From

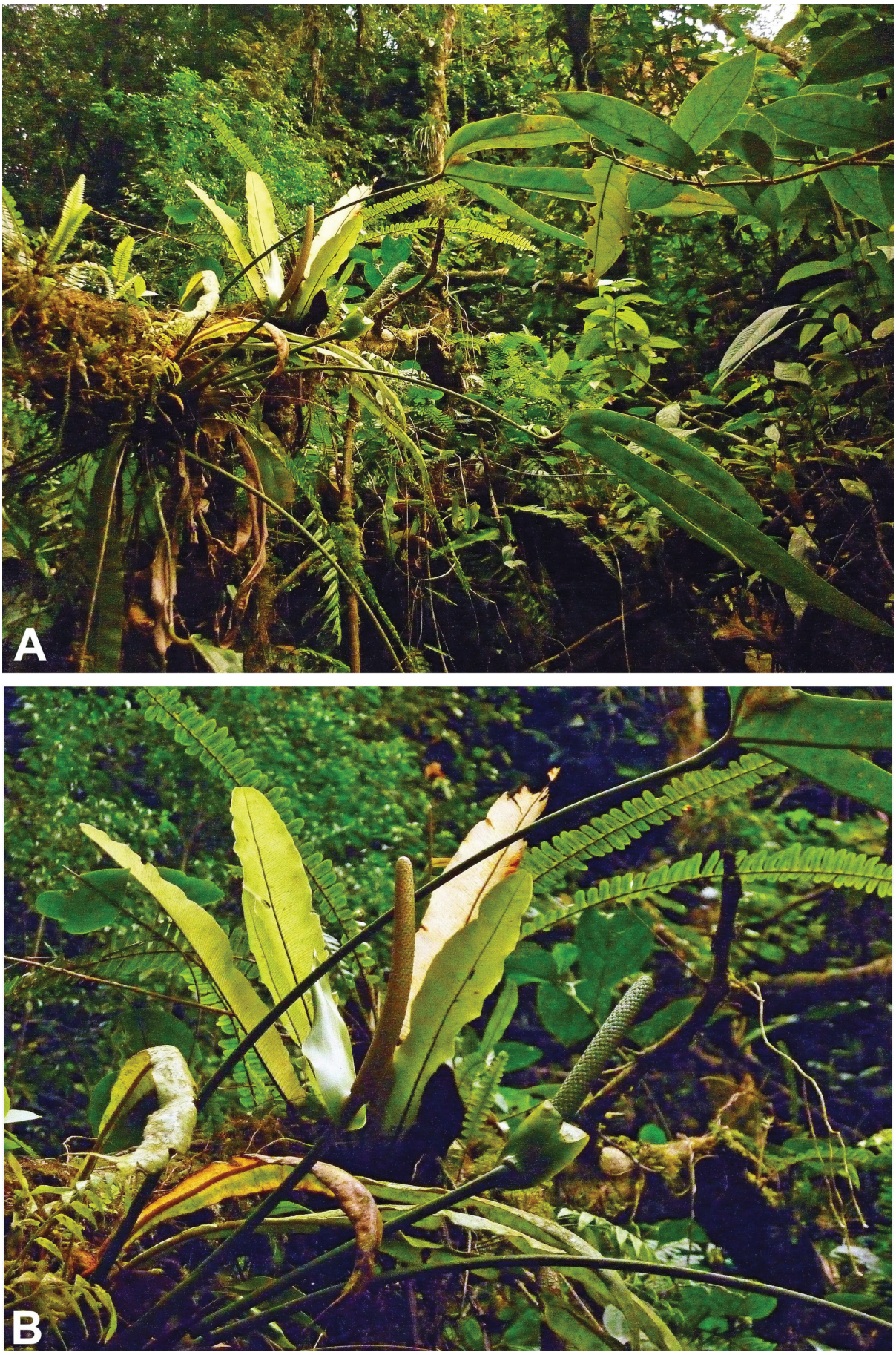

FIGURE 17. *Anthurium orlandoi* Croat: **A**. Habit. **B**. Inflorescences. Photo credits: Orlando O. Ortiz.

Escuela Agricola Alto de Piedra, on road to Río Calovébora, along stream, 08°31'54"N, 81°08'45"W, 731 m, 7 Oct 1979, *T. Antonio 2036* (MO!); La Fortuna hydroelectric Project, in Cloud forest along trail behind camp, 08°43'N, 82°14'W, 1200–1400 m, 21 Mar 1978, *B. Hammel 2122* (MO!).

Anthurium orlando-ortizii Croat, *sp. nov.* (Fig. 16C)

Anthurium orlando-ortizii is characterized by its epiphytic life form, short internodes, cataphylls persisting as pale fibers, moderately short-petiolate leaves, subterete petioles drying with fine moderately granular ribs, narrowly ovate-sagittate, greenish-drying, gradually acuminate blades with a narrowly parabolic to somewhat spathulate sinus, 6 pairs of basal veins, two pairs of which are free to the base. 12–14 pairs of primary lateral veins, collective veins arising from the 2nd or 3rd pair of basal veins, as well as by the moderately short-pedunculate inflorescence, the oblong-lanceolate green spathe and the subsessile, narrowly long-tapered white spadix tinged with pink.

Type:—PANAMA. Colón: Donoso, afueras del área de la concesión de Minera Panamá, al sur de Helipad PC7, 08°56'02"N, 80°45'52"W, 64 m, 24 Aug 2012, *O.O. Ortiz, A. Zapata, B. Castro, E. Sánchez 819* (holotype MO!, isotype PMA).

Epiphyte: **internodes** short, 0.8 cm diam; **cataphylls** 2.8–3.0 cm long, drying pale brown, persistenting as fibers. Leaves with **petioles** subterete, with moderately granular ribs, 33.5–38.4 cm long, 4–5 mm diam.; geniculum 1.6–2 cm long, drying blackish; **blades** narrowly ovate-sagittate, gradually acuminate, 43.9–46.4 × 17.0–19.2 cm, 2.5 times longer than broad, 1.3 times longer than petioles, dark green, semi-glossy above, paler green, matte below, drying dark greenish-brown above, paler greenish-brown below; **anterior lobe** 37.6–42.6 × 17.0–19.2 cm, broadest at 3–5 cm above petiolar plexus; **posterior lobes** 9.3–10.0 × 5.8–7.7 cm, directed at 60–63°; **sinus** parabolic to somewhat spathulate, 6.3–8.0 cm deep, 2.4–3.6 cm wide; **midrib** drying acute, moderately raised above, blunt, more prominently raised, lightly puberulent below; **primary lateral veins** 12–14 pairs, arising 45–50°, weakly raised above, blunt acute, moderately raised, lightly scaly below; **basal veins** 6 pairs, 1st and 2nd pairs free to base, 3rd pair fused 1.5–1.6 cm, 4th pair fused 1.9–2.1 cm; **posterior ribs** 1.8–2.7 cm long, naked 1.7–2.1 cm; tertiary veins rounded, very weakly raised above, rounded, weakly raised below; **collective veins** arising from 2nd or 3rd basal veins, 4–7 mm from margin; upper surface drying very granular, lower surface moderately brown-speckled. **Inflorescence** with **peduncle** green, 17.8 cm long, drying 2 mm diam.; **spathe** oblong-lanceolate green, reflexed, 10.9 × 1.2 cm; **spadix** sub-sessile, white with pink tingeing, 9.4 cm long, 0.4 cm diam.; **flowers** 10 visible per spiral, 1.1 × 0.9 mm; tepals drying light brown, granular, lateral tepals 0.5 mm wide, inner margin rounded, outer margin 2-sided. **Berries** not seen.

Eponymy:—The species is named in honor of Panamanian botanist Orlando Ortiz who collected the type specimen. Orlando has been collecting plants in many parts of Panama and collects many interesting Araceae. The species epithet was proposed by the second author of this work, Thomas B. Croat, who considered using it on his own initiative.

Habitat and distribution:—*Anthurium orlando-ortizii* is endemic to Panama, known only from the type locality in Colón Province at 64 m elevation in a *Tropical wet forest* life zone.

Phenology:—Flowering in August.

Discussion:—This species is a member of sect. *Cardiolonchium*, where it is most similar to *A. ochranthum* which differs by its terrestrial life form, 4–6 pairs of primary lateral veins and yellow spadices. In the Lucid *Anthurium* key the species tracks to *A. alstonii* Croat (in Croat *et al.* 2010) which differs in the arcuate sinus of the leaf blade and a long spadix stipe, and to *A. versicolor* Sodiro (1901: 13) which differs in having more broadly ovate leaf blades that have narrowly raised major veins on the upper surface as well as by the more nearly cylindroid yellowish spadix.

Conservation status:—Data deficient (DD).

Anthurium picadoae O.Ortiz & Croat, *sp. nov.* (Fig. 16D)

Anthurium picadoae is characterized by its epiphytic life form, short internodes, persistent cataphyll fibers, subterete petiole, small oblong-lanceolate, grayish brown-drying, weakly acuminate blade with rounded to weakly subcordate base, narrowly and acutely raised midrib, collective veins arising from the innermost of the two pairs of basal veins and running moderately close to the margins, as well as by the inflorescence with a moderately long peduncule, narrowly ovate, purplish violet-tinged erect-spreading spathe and a long-stipitate, cylindroid, purplish violet spadix.

Type:—COSTA RICA. Cartago: Cantón de Paraiso, Cordillera de Talamanca, Finca El Sitio, sendero a la catarata, 3 km E de Villa Mills, 09°34'30"N, 083°41'10"W, 2650 m, 2 Mar 1996, *A. Picado & B. Gamboa 345* (holotype MO!, isotype CR!).

Epiphyte; **internodes** short, 2 cm diam.; **cataphylls** 10.5–13.0 cm long, initially gray-brown, matte, finely striate, becoming fibrous at the base and eventually throughout its length. Leaves with **petioles** 22.6–31.7 cm long, sheathed for 2.7–3.6 cm at base, 2–3 mm diam., drying gray-brown, coarsely ribbed longitudinally; geniculum 1.0–1.7 cm long, drying darker; **blades** oblong-lanceolate, 19.4–32.5 × 5.6–8.2 cm; 2.1–4.2 times longer than wide, 0.7 to 1.1 times longer than petioles, narrowly acute to weakly acuminate or apiculate at apex, rounded to weakly subcordate at base, dark green and weakly bicolorous, moderately coriaceous, matte above, weakly glossy below; **midrib** drying narrowly acute and prominently raised, concolorous above, narrowly acute and prominently raised, paler below; **primary lateral veins** 7–10 pairs, arising at 40–45° angle, weakly raised and narrowly rounded, concolorous above, more prominently raised and concolorous below; **basal veins** 1–2 pairs; **collective veins** arising from the innermost of two basal veins, 3–7 mm from margin; upper surface drying moderately smooth, minutely granular on magnification; lower surface densely and conspicuously net-reticulate. **Inflorescence** erect; **peduncle** 21 cm long; **spathe** 6.5 × 2.3 cm, green tinged with red to purple-violet, erect-spreading, drying dark brown; **spadix** stipitate 1.8 cm (stipe 1.5 mm diam.), 5.8 cm long, 5 mm diam., purple-violet; **flowers** 5 per spiral, 1.8–2.0 mm long and wide; tepals moderately smooth; lateral tepals 1.2–1.4 mm wide; inner margins rounded, outer margins (2)3-sided; stamens included; anthers 1 mm long, 0.6 mm wide; thecae oblong, scarcely divaricate. **Berries** not seen.

Eponymy:—The species is named in honor of Costa Rican entomologist Annia Picado who collected the type specimen. Annia worked at INBio in Costa Rica, where she was noted for developing an extensive collection of flies, as well as for her studies on *Ceratopogonidae*.

Habitat and distribution:—*Anthurium picadoae* is endemic to Costa Rica, known only from the Cordillera de Talamanca in Cartago Province at 2650–2760 m in a *Lower montane rain forest* life zone.

Phenology:—Flowering in March.

Discussion:—*Anthurium picadoae* is a member of Sect. *Pachyneurium* and is closest to *A. ranchoanum* with which it has been confused. The last species differs from *A. picadoae* in having more coriaceous, more oblong-ovate blades which are more cordate at the base or are decurrent on the petioles at the very base, with 3–6 pairs of basal veins, have more widely spaced primary lateral veins and proportionately longer, more prominently stipitate spadices with more flowers visible per spiral (7 or more) and prominently exserted stamens.

Conservation status:—Data deficient (DD).

Anthurium ptenospathum Croat & O.Ortiz*, sp. nov.* (Fig. 18A)

Anthurium ptenospathum is characterized by its epiphytic life form, short internodes, dense roots, long slender cataphylls which persist as pale fibers, moderately long petioles drying sharply sulcate, a narrowly oblong-oblanceolate, grayish-drying blade with about 18 pairs of primary lateral veins and the collective veins arising from the lower primary lateral veins as well as by its pendent infructescence with berries purplish when young and green when mature.

Type:—PANAMA. Bocas del Toro: Campamento La Pata de Cedro, como 800 m hacia arriba, 09°03’58”N, 82°43’56”W, 1525 m, 10 Mar 2004, *E. Alfaro & A.K. Monro 5474* (holotype PMA!).

Epiphytic; **stems** less than 20 cm long; **internodes** short, 2 cm diam.; roots dense; **cataphylls** 13.0–17.5 cm long, drying pale yellow-brown, persisting as thin pale more or less parallel fibers with fragments of brown epidermis. Leaves with **petioles** 30 cm long, 4 mm diam., drying greenish gray, somewhat glossy, sharply and broadly sulcate with weakly raised lateral margins, the sulcus faintly many-ribbed; **blades** oblong-oblanceolate, 60.0 × 8.5 cm, 7 times longer than broad, 2 times longer than petiole, apex missing, narrowly acute at base, subcoriaceous, drying grayish, scarcely bicolorous; **midrib** drying acute, finely ribbed, concolorous above, acute, finely ribbed and much thicker below; **primary lateral veins** 17–19 pairs, arising at 50–60° angle, drying weakly raised, narrowly rounded and concolorous above, narrowly round-raised and slightly paler below; **collective veins** arising from the lowermost primary lateral veins, running 2–3 mm from margin, moderately straight, about equal in prominence to the primary lateral veins; tertiary veins moderately obscure. **Inflorescence** spreading-pendent, much shorter than leaves; **peduncle** 23 cm long, slightly narrower than petiole; **spathe** green, lanceolate; **spadix** 10 cm long, 1.5–2.0 cm diam.; **flowers** 5–6 visible per spiral, 2.2–2.5 mm long and wide; lateral tepals 1.2 mm wide; turned upward on drying, inner margin rounded, outer margins 2-sided. **Infructescence** with fruiting spadix 11.5 cm long, 1.5 cm diam. **Berries** purplish violet when young, maturing green; stigma cupuliform, broadly oval to round, slightly raised.

Eponymy:—The species epithet comes from the Greek “pteno” (meaning deciduous-) and spathe (in both Green and Latin) referring to its deciduous spathe.

FIGURE 18. Holotype specimens: **A**. *Anthurium ptenospathum* Croat & O. Ortiz. **B**. *Anthurium pucuroense* O. Ortiz & Croat. **C**. *Anthurium ratonense* Croat & O. Ortiz. **D**. *Anthurium sixaolense* Croat, D. Belt & O. Ortiz.

Habitat and distribution:—*Anthurium ptenospathum* is endemic to Panama, known only from the type locality in Bocas del Toro Province at 1525 m in a *Lower montane rain forest* life zone.

Phenology:—Flowering and fruiting in March.

Discussion:—*Anthurium ptenospathum* is tentatively a member of section *Pachyneurium* and is most closely related to *A. prolatum* Croat & Baker (1979: 72) which differs by its proportionately much longer leaf blades with 25–40 pairs of primary lateral veins, its much longer spadix to 60 cm long and mature orange berries. In the Lucid *Anthurium* key the species tracks to *A. caucavallense* Croat (1991: 623) from Colombia which is a typical member of sect. *Pachyneurium* with thick, erect leaves arranged in a rosette with a stout peduncle; *A. infectorium* Schultes (1964: 336) from Colombian Amazonia, differing by having more nearly elliptic blades with fewer than 7 pairs of primary lateral veins; *A. nemoricola* Schultes (1953: 61) from Colombian Amazonia, differing by being a much smaller terrestrial plant with narrowly ovate blades; *A. oerstedianum* Schott (1858: 180), differing by its ovate blades with a very remote geniculum.

Conservation status:—Data deficient (DD).

Anthurium pucuroense O.Ortiz & Croat, *sp. nov.* (Fig. 18B)

Anthurium pucuroense is characterized by its epiphytic life form, slender stem with short internodes, slender, dark brown-drying, early deciduous cataphylls, terete petiole, narrowly ovate-sagittate, brown-drying, moderately bicolorous blades, short-pedunculate inflorescence with a linear-lanceolate green, reflexed spathe and long-stipitate, cylindroid-tapered green spadix with protruding stamens and yellow anthers.

Type:—PANAMA. Darién: Parque Nacional del Darién, Cerro Mali, headwaters of S. branch of Río Pucuro, ca. 22 km E. of Pucuro, primary forest dominated by *Dictyocaryum platysepalum*; 08°04.5'N, 77°14'W, 1250–1500 m, 20–26 Oct 1987, *G. de Nevers*, *H. Cuadros*, *B. Hammel* & *H. Herrera 8494* (holotype MO!).

Epiphyte; stems 1.5 cm diam.; **internodes** short, 0.5 cm long; **cataphylls** 11.5 cm long, narrow, seemingly deciduous. Leaves with **petioles** 47.5 cm long, terete, drying reddish brown, matte, coarsely ribbed; **blades** narrowly ovate-sagittate, 40 × 26 cm, 1.5 times longer than broad, broadest at petiolar plexus, subcoriaceous, dark green and matte above, moderately paler and semiglossy below, drying dark brown and matte above, moderately paler, grayish yellow-brown and semiglossy below; **anterior lobe** 29.3 cm long, broadly concave along margins; **posterior lobes** 15.0 × 9.3 cm; **sinus** hippocrepiform, 11.5 cm deep, 7.5 cm wide; **basal veins** 7 pairs, 1st pair free to base, 2nd fused 8 mm, 3rd pair fused 2.7 cm, 4th pair fused 4.8 cm; 5th pair fused 6.3 cm; **posterior rib** weakly curved, 6.3 cm long, naked 4 cm; **midrib** raised below, sunken above; **primary lateral veins** 10 pairs; **collective veins** arising 1st basal vein, 0.8–1 cm from margin. **Inflorescence** erect, much shorter than leaves; **peduncle** 9 cm long; **spathe** green, reflexed, 8.7 × 1.2 cm, narrowly long-acuminate; **spadix** green, 15.3 cm long, 0.7–1.0 cm diam., narrowly cylindroid-tapered, prominently stipitate, stipe 2.1 cm long, 2 mm diam.; **flowers** 7 visible per spiral, 3.6–4.0 × 3.2–4.0 mm, drying matte, brown; tepals moderately smooth, drying dark yellow-brown, matte; lateral tepals 1.8–2.2 mm wide; inner margin narrowly rounded, outer margins 2-sided; stamens moderately emergent with white filaments; anthers 7–8 mm long and wide; thecae scarcely divaricate. **Berries** not seen.

Eponymy:—The species is named for the type locality along the Río Pucuro in Darién Province.

Habitat and distribution:—*Anthurium pucuroense* is endemic to Panama, known only from the type locality in Darién Province at 1250–1500 m in a *Tropical wet forest* life zone.

Phenology:—Flowering in October.

Discussion:—*Anthurium pucuroense* is an unusual member of sect. *Calomystrium* and has been confused with *A. crystallinum* (sect. *Cardiolonchium*) but that species differs by having blades broadest nearer to the middle, the upper surface conspicuously velvety with prominently paler major veins, a narrow or closed sinus and a nearly sessile, more long-tapered yellowish spadix. In the Lucid *Anthurium* key the species tracks to *A. flavoviride* Engler (1898: 447) which differs by having more broadly ovate, more coriaceous blades with a length to width ratio of 1.2; *A. fusiforme* Croat (1986b: 102) differs by having a white fusiforme spadix; *A. hoffmanii* differs by having a much broader, erect spathe and sessile spadices; *A. modicum* differs by having much larger blades with the collective veins arising from the lower basal veins, conspicuous glandular punctations on the lower blade surface and a subsessile spadix; *A. nymphaeifolium* Koch & Bouché (1853: 6) differs by a narrowly ovate-erect, much broader spathe and *A. yarumalense* Engler (1898: 441), differs by having more coriaceous, blackish drying blades with a parabolic sinus and subsessile spadix.

Conservation status:—Data deficient (DD).

***Anthurium ratonense* Croat & O.Ortiz, *sp. nov.* (Figs. 18C, 19)**

Anthurium ratonense is characterized by its terrestrial life form, persistent pale cataphyll fibers, subterete, pale yellow-brown-drying petioles, narrowly ovate-sagittate, narrowly long-acuminate, greenish-drying blades with a spathulate sinus, slender incurved posterior lobes, 5(6) pairs of basal veins, a curved posterior rib which is naked throughout most of its length, 5–6 pairs of primary lateral veins, upper surface grayish and lower surface greenish yellow as well as by the narrowly pedunculate inflorescence which is much shorter than the leaves, a blackish ovate-subcordate spreading spathe and the prominently stipitate ovoid whitish spadix with protruding stamens.

Type:—PANAMA. Comarca Ngäbe-Buglé: Ratón, Parcela 10, Nole Duima/Kankintú, Filo de la Cordillera, Este de Buena Vista, 08°31'58"N, 81°48'05"W, 1684 m, 26 Aug 2012, *A. Ibañez, M. Ayala, A. Celis & N. Flores 8139 AI* (holotype PMA!).

Terrestrial to about 1 m tall; stem moderately short; **internodes** about as long as broad or broader than long, 1–3.5 cm long; **cataphylls** 9.5 cm long, persisting as pale parallel fibers and large fragments of epidermis. Leaves with **petioles** 32.5–46.5 cm long, drying 2 mm diam., pale yellow-brown, the surface minutely granular and short-raised striate; geniculum 8 mm long, blackened, not shrunken; **blade** narrowly triangular-sagittate, 28–30 × 13.0–13.5 cm, 0.6–0.8 times as long as petiole, narrowly-long-acuminate at apex, deeply lobed at base, subcoriaceous, dark green and matte above, moderately paler and semiglossy below; **anterior lobe** 20.5–21.5 long, straight to weakly convex, sometimes weakly concave along margins; **posterior lobes** 7.5–8 × 13–13.5 cm, directed toward base and curved inward; **sinus** spathulate 8.5–9.0 cm deep, 3.4–4.0 cm wide; **basal veins** 5–6 pairs, 1st pair free to the base, 2nd pair fused to 1 cm, 3rd fused to 3 cm, 4th & 5th fused to 5 cm; **posterior ribs** weakly curved, naked most of their length; **midrib** narrowly raised and often drying acute, concolorous above, narrowly rounded and paler, irregularly granular below; **primary lateral veins** 5–6 pairs of primary lateral veins arising at 40° angle; **collective veins** arising from 2nd to 3rd pairs of basal veins, 0.2–0.5 mm from margin; tertiary veins moderately distinct below; upper surface sparsely granular; lower surface with moderately distinct granules in the areoles. **Inflorescence** erect, much shorter than leaves; **peduncle** 20 cm long, slender, drying 3 mm diam., narrowly ribbed, granular, drying greenish yellow; **spathe** spreading , narrowly ovate-subcordate, 3.5 × 2.3 cm, dark blackish purple, glossy on inner surface; **spadix** stipitate 6 mm, narrowly ovoid, 1.3 cm long, 6 mm diam. greenish yellow; **flowers** 4 visible per spiral, 2.5–3 × 3.5 mm; tepals smooth, lateral tepals 1 mm wide, inner margin narrowly rounded, outer margin 2-sided, narrowly rounded at the union of the two sides; stamens exserted ca. 1 mm; anthers 0.6 mm long. **Berries** not seen.

Eponymy:—The species is named for the type locality along the Ratón town from Kankintú, Comarca of Ngäbe-Buglé.

Habitat and distribution:—*Anthurium ratonense* is endemic to Panama, known only from the type locality in the Comarca Ngäbe-Buglé at 1684–1723 m in a *Lower montane rain forest* life zone.

Phenology:—Flowering in August.

Discussion:—*Anthurium ratonense* is probably an unusual member of Sect. *Pachyneurium* owing to its likely close relationship with *Anthurium watermaliense* and *A. kirkdukeorum* (described in this work). The last two mentioned species differ from *A. ratonense* by having a longer (generally more than 5 cm long), lanceolate spathe which is markedly decurrent into peduncle and long-tapered spadices of 7–10 cm long with 5–12 flowers visible in the principal spiral and 6–16 flowers visible in the alternate spiral.

Conservation status:—The area surrounding the type locality of this species is severely affected by unsustainable agricultural and livestock activities. Given its restricted natural distribution (area of occupancy: 8 km^2) and the continuous peril of its habitats, we strongly recommend considering *A. ratonense* as an critically endangered species [CR B1ab(ii,iii,iv,v)+B2ab(ii,iii,iv,v)].

Additional specimens examined (paratypes):—PANAMA. Comarca Ngäbe-Buglé: Cordillera Central, Kankintú, Filo de la Cordillera, Buena Vista Oeste, Ratón, parcela 5, bosque montano maduro, 08°32'08"N, 81°48'15"W, 1723 m, 24 Aug 2012, *A. Celis, M. Ayala, N. Flores, A. Ibáñez & J. Castillo 495 ACT* (MO!, PMA!).

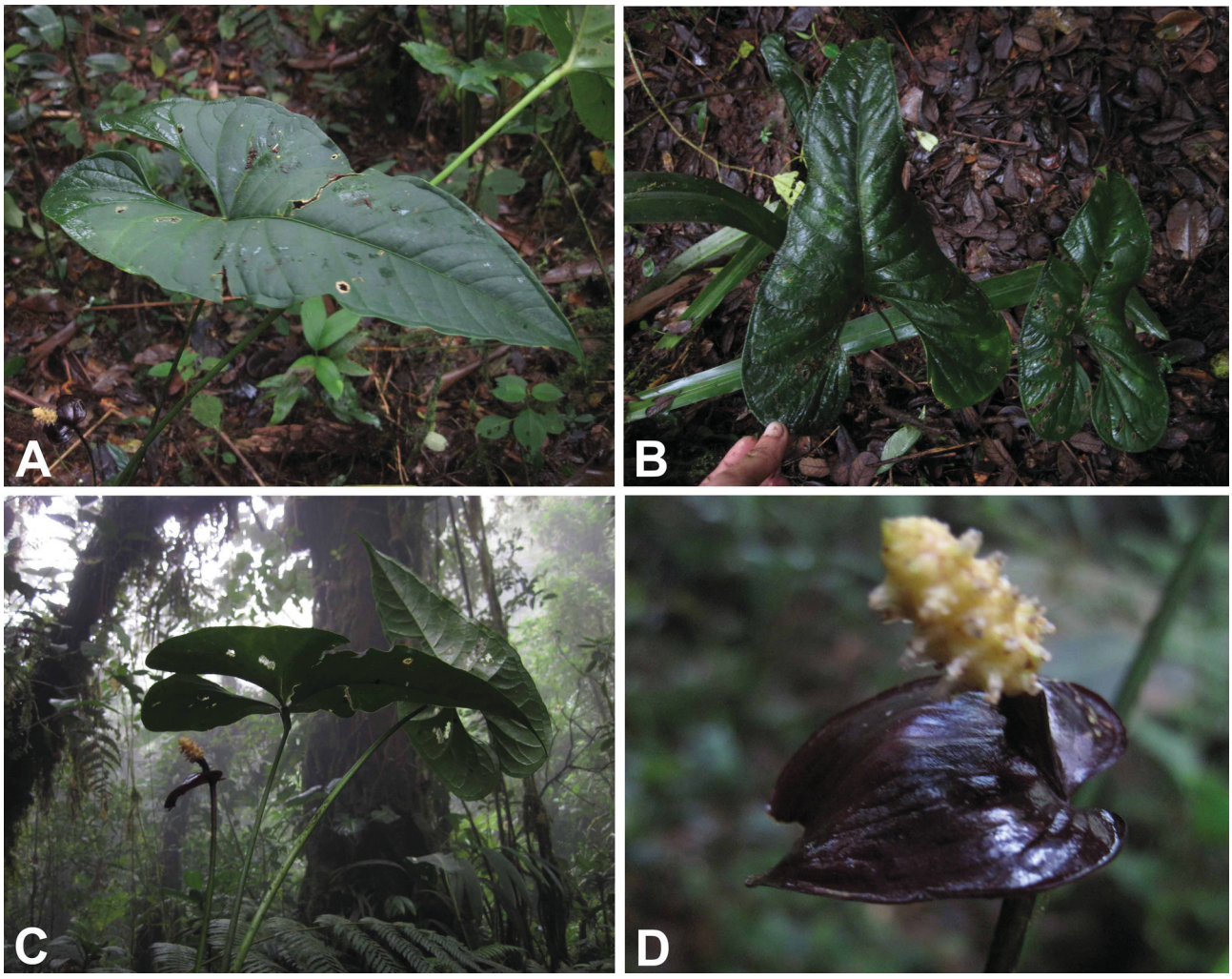

FIGURE 19. *Anthurium ratonense* Croat & O. Ortiz: A. Leaf blade and inflorescence. B. Leaves (adaxial surfaces). C. Leaf blade (abaxial surface) and inflorescence. D. Inflorescence (close up). Photo credits: Alicia Ibáñez.

Anthurium sixaolense Croat, D.Belt & O.Ortiz, *sp. nov*. (Figs. 18D, 20)

Anthurium sixaolense is characterized by having epiphytic life from, short internodes, cataphylls persisting as fibers, triangular-sagittate blades which are distinctly short pale-lineate above, 8–9 pairs primary lateral veins, 7 pairs of basal veins, broadly parabolic sinus, erect-recurved, linear-lanceolate green spathes, green spadices at post-anthesis with flowers 9–10 visible per spiral and greenish-white berries

Type:—COSTA RICA. Limón: Parque Nacional La Amistad, Cuenca del Sixaola, Camp 2, ridge above camp (1), 09°31'13"N, 083°12'31"W, 1700–1715 m, 22 Feb 2007, *A.K. Monro & D. Santamaría 5547* (holotype MO!, isotype CR!).

Epiphytic, at 1.5 m on tree-trunk; **internodes** short, 2.5 cm diam.; **cataphylls** persisting as fibers, drying orange-red to dark reddish brown; **petioles** 56.5 cm long, 7 mm diam. midway, subterete, sulcate, drying dark reddish brown, semiglossy; geniculum 2 cm long, drying darker than petiole; **blades** triangular-sagittate, 69 × 43 cm, broadest near ends of the posterior lobes, 40 cm wide at the petiolar plexus, 1.6 times longer than wide, 1.2 times longer than petiole, gradually long-acuminate, prominently lobed at base, drying subcoriaceous, dark reddish brown, matte above, light reddish brown and glossy below; upper surface distinctly but minutely short pale-lineate, densely dark brown punctiform-speckled near tip of blade on adaxial surface; lower surface distinctly dense brown-speckled, dark punctations absent on either surface; **anterior lobe** 54 cm long, broadly concave, drying with weakly undulate margins; **posterior lobes** somewhat spreading at ca. 120° angle, directed downward and outward, 22.5 × 13.8 cm; **midrib** drying rounded, concolorous, and flattened toward the apex above and rounded, weakly ribbed and concolorous below; **primary lateral veins** 8–9 pairs curving prominently upward along and merging with the margin, drying reddish

FIGURE 20. *Anthurium sixaolense* Croat, D. Belt & O. Ortiz. Photo credits: Alex Monro.

brown, narrowly rounded above and below; tertiary veins drying indistinct above, weakly raised below; **collective veins** arising from the upper primary lateral veins, 2–3 mm from margin; **basal veins** 7 pairs, 1st pair, free to the base, 2nd fused 1.5 cm, 3rd pair fused 5 cm, 4th pair fused 8 cm, 5th & 6th fused 9.7 cm; **posterior ribs** gradually curved, 8 cm, naked nearly its entire length; **sinus** broadly parabolic, 13.5 cm deep, 17 cm wide. **Inflorescence** with **peduncle** 33 cm long, 9 mm diam. at base, 5 mm diam. midway, drying dark brown, matte, 2.2 times longer than spathe; **spathe** green, 18.5 × 1.5 cm, erect-recurved, linear-lanceolate, drying dark reddish brown, outer surface with whitish punctiform deposits of crystals; **spadix** 19 cm long, 1.5 cm diam. (post-anthesis), weakly stipitate, green post-anthesis with juvenile berries beginning to emerge; **flowers** 9–10 visible per spiral, 1.8 × 1.9–2.1 mm; lateral tepals 1.0–1.2 mm wide, inner margin rounded, outer margins inequilaterally 2-sided; anthers 0.4 × 0.6–0.7 mm with the thecae narrow and marginal, subparallel. **Berries** white.

Eponymy:—The species is named for the type locality in the valley of the Rio Sixaola in Limón Province.

Habitat and distribution:—*Anthurium sixaolense* is known only from the type locality in Costa Rica at 1700–1715 m in a *Premontane rain forest* life zone.

Phenology:—Flowering and fruiting in February.

Discussion:—This species is a member of sect. *Belolonchium* and was long confused with *A. clavatum*, which is a member of the sect. *Calomystrium*. The last species differs from *A. sixaolense* in having persisting intact cataphylls, green to creamy-white claviform spadices and yellowish-orange berries. In the Lucid *Anthurium* key the species tracks to *A. brownii* which differs by having persisting ± intact cataphylls and infructescences with reddish-brown to orange spadices with bright-orange berries; *A. cogolloanum* which differs by having quadrangular-winged petioles, leaf blades with 13–19 pairs of primary lateral veins and whitish spathes; *A. vomeriforme* Sodiro (1901: 14) which differs by having leaf blades usually drying gray-green to yellow-green (sometimes dark yellow-brown) with a usually hippocrepiform to spathulate sinus and inflorescence with cucullate spathes.

Conservation status:—Data deficient (DD).

Anthurium sonaense Croat & O.Ortiz, *sp. nov.* (Fig. 21A)

Anthurium sonaense is characterized by its epiphytic life form, short thick internodes short, persistent intact cataphylls, subterete weakly sulcate petioles, ovate-sagittate brown-drying, gradually short-acuminate blades, which are dark-punctate below and short pale-lineate on both surfaces, 6 pairs of basal veins with a broadly parabolic sinus, 6 pairs of basal veins, the 1st pair of which is free to the base, a posterior rib which is naked nearly throughout, as well as by the greenish yellow spreading spadix, and the cylindroid, purplish, weakly stipitate spadix.

Type:—PANAMA. Veraguas: Soná, Bahía Honda, bosque en Playa de Juana, bosque maduro, 7°42'14.56"N, 81°28'8.54"W, 100 m, 14 Mar 2002, *A. Ibáñez, M.P. Martín, M.A. García & R. Mendoza 1833 AI* (holotype MO!, isotype PMA!).

Epiphyte; **internodes** short, 2.2–3.0 cm diam.; **cataphylls** more than 15 cm long, persisting intact. Leaves with **petiole**s subterete, weakly sulcate, 60 cm long, 1 cm diam., drying dark brown; geniculum 4 cm long, drying darker; **blades** ovate-sagittate, 62 × 41 cm, 1.5 times longer than wide, 0.9–1.0 times as long as blade, gradually short-acuminate at apex, prominently lobed at base, subcoriaceous, dark green above, somewhat bicolorous, drying dark brown and matte above, somewhat paler yellowish brown, weakly glossy and dark-punctate below, short pale-lineate on both surfaces; **anterior lobe** 45 cm long, convex along margin; **posterior lobes** 20 × 16 cm; **sinus** broadly parabolic, 7.5 cm deep, 14 cm wide, major veins weakly raised, concolorous above, drying darker brown below; **basal veins** 6 pairs, 1st pair free to base; 2nd pair fused 2.5 cm; 3rd pair fused 3.5 cm , 4th pair fused 4.5 cm; 5th pair fused 5.5 cm; **posterior ribs** 6.5 cm long, weakly curved, naked nearly throughout; **midrib** raised on both surfaces; **primary lateral veins** fewer than 6 pairs, narrowly rounded concolorous above, narrowly rounded below, drying undulated; **collective veins** arising from one of the lower primary lateral veins, 4–10 mm from margin, markedly looping between primary veins. **Inflorescence** erect; **peduncle** 69 cm long; **spathe** lanceolate, 9.0 × 2.5–3.0 cm, greenish yellow spreading, gradually short-acuminate and long-acicular at apex; **spadix** cylindroid, purplish, weakly stipitate (stipe 4 mm long, 5 mm diam.), 11 cm long, 1.2 cm diam.; **flowers** 7 visible per spiral; 2.2 mm long and wide; lateral tepals 1.7 mm wide, broadly rounded on inner margin, 2-sided on outer margin. **Berries** not seen.

Eponymy:—The species epithet comes from the type locality near Soná in Veraguas Province in Panama.

Habitat and distribution:—*Anthurium sonaense* is endemic to Panama, known only from the type locality in Veraguas Province along the Pacific slope at 100 m in a *Tropical wet forest* life zone.

Phenology:—Flowering in March.

FIGURE 21. Holotype specimens: **A**. *Anthurium sonaense* Croat & O. Ortiz. **B**. *Anthurium tayloranum* Croat & O. Ortiz. **C**. *Anthurium tenuireticulum* Croat & O. Ortiz. **D**. *Anthurium tifense* Croat & O. Ortiz.

Discussion:—This species is a member of sect. *Calomystrium*. In this section, *A. sonaense* is most similar to *A. sanctifidense* which occurs mainly on the Caribbean slope of Panama. The latter species differs from *A. sonaense* by its usually terrestrial life form, leaf blades with 2–3 pairs of basal veins free to the base and short-pale lineations below, uniform-green spathes and greenish white spadices with 7–17 flowers visible in the principal spiral. In the Lucid *Anthurium* key the species tracks to *Anthurium clavatum* which differs by its green to creamy-white clavate spadix; *A. colonense* Croat (1986b: 60), differing by its blackish-drying leaf blades, two pairs of basal veins free to the base and a much longer more narrowly tapered, yellow spadix ; *A. limonense* Grayum (1997: 32), differing by having blades without short pale-lineations and dark-punctations, collective veins arising from the lower basal veins and short peduncles (6.4–7.5 cm).

Conservation status:—This species is only known from a single locality and comprises an area of occupancy of 4 km^2. The greatest threat this species is facing is the loss of habitat caused by destructive livestock activities and urban constructions for coastal tourism. Because human and livestock activities threatens the integrity of the habitats of this species, we consider that *A. sonaense* can be assessed as a critically endangered species, CR B2ab(ii,iii,iv).

Anthurium tayloranum Croat & O.Ortiz*, sp. nov.* (Fig. 21B)

Anthurium tayloranum is characterized by its epiphytic life form, moderately short and slender internodes, persisting pale fibrous cataphylls, long-petiolate narrowly ovate-subcordate blades which are narrowly acute at the apex and dry brownish green with collective veins arising from the base as well as by the moderately long-pedunculate inflorescence which is about as long as the petioles, an ovate-cordate green spreading spathe and a stipitate cylindroid purplish spadix.

Type:—PANAMA. Veraguas: Along road between Escuela Agricola Alto Piedra (above Santa Fe de Veraguas) and Río Dos Bocas, ca. 10 km N of school, 530–620 m, 26 Jul 1974, *T.B. Croat 25902* (holotype MO!).

Epiphyte; **internodes** short, 1 cm diam. at apex (the younger portion narrowly tapered with internodes 6–8 mm long, 3–4 mm diam.); **cataphylls** to 13 cm long, slender, promptly becoming pale-fibrous but with only the lower portion of the fibers persistent, these largely parallel. Leaves moderately long-petiolate; **petioles** obscurely sulcate, 22–24 cm long, drying 3 mm diam., light brown; geniculum 8–10 mm slightly shrunken, slightly darker; **blades** narrowly ovate-oblong, narrowly acute at apex, weakly subcordate at base, drying grayish to gray-brown and matte above, grayish green and semiglossy below, 22.5–30.8 × 6.1–8.0 cm, 3.7–4.8 times longer than wide, broadest in lower 1/3, 1.0–1.3 times longer than petioles; **sinus** 4–5 mm deep; **basal veins** 1–2 pairs, free to the base; **midrib** narrowly rounded and concolorous, drying weakly ribbed above, narrowly rounded and paler below, drying several ribbed; **primary lateral veins** 8–10 pairs, arising at 50–55° angle; **collective veins** arising from 1st pair of basal veins, 2–3 mm from margins; tertiary veins drying weakly prominulous above, prominently raised below. **Inflorescence** erect, much shorter than leaves, about as long as petioles; **peduncle** 19 cm long, 2 mm diam.; **spathe** purplish, 3.0 × 1.8 cm, clasping and cordate at base; **spadix** purplish, stipitate 2 mm, 2.7 cm long, 5 mm diam., ca. 5.5 times longer than broad; **flowers** 5–6 visible per spiral, 1.6 mm long and wide; tepals dusty-granular; lateral tepals 1 mm wide; inner margins rounded, outer margin 2–3-sided; stamens not seen. **Berries** not seen.

Eponymy:—The species is named in honor of our old friend Dr. Albert Taylor, Professor Emeritus at the University of Panama and expert on Cycadaceae and Zamiaceae of Panama. Dr. Taylor has been a constant presence at the Universidad de Panama and has assisted both authors greatly over many years at the institute.

Habitat and distribution:—*Anthurium tayloranum* is endemic to Panama, known only from the type locality in Veraguas Province at 530–620 m in a *Tropical wet forest* life zone.

Phenology:—Flowering in July.

Discussion:—*Anthurium tayloranum* is an unusual member of sect. *Pachyneurium* and is apparently most closely related to a few non-traditional members of this section, especially *A. ranchoanum* which differs by its thicker stems (up to 4.5 cm diam.), much larger leaf blades (17–64 cm long) with much larger posterior lobes and by the hooding spathe, and *A. protensum* Schott (1858: 181) subsp. *arcuatum* Croat (1986b: 164) (treated here as a distinct species, see below), which differs by having proportionately much longer leaf blades (19–51 cm long) and hooding and proportionately narrower spathes. In the Lucid *Anthurium* key the species tracks to *A. brevispadix* Croat (1986b: 40), differing by having proportionately much narrow leaves (2.0–2.8 cm wide) acute at the base with a much more long-tapered spadix; *A. brenesii* Croat & Baker (1979: 28), differing by having much longer (32–68 cm long), proportionately narrower blades acute at the base ,as well as by the hooding spathe which remains erect.

Conservation status:—This species is known only from one location (Santa Fe), which is included in the

protected area of Santa Fe National Park. In the absence of population data and information about its potential threats, *A. tayloranum* can be assessed as data deficient (DD).

Anthurium tenuireticulum **Croat & O.Ortiz,** ***sp. nov.*** **(Figs. 21C, 22)**

Anthurium tenuireticulum is characterized by its epiphytic life form, short thick internodes, lanceolate cataphylls persisting as a fine semi-intact network of pale fibers, moderately long-petiolate leaves with 5-ribbed petioles (3-ribbed abaxially and broadly and sharply sulcate adaxially), narrowly oblanceolate, grayish green-drying, gradually acuminate blades with collective veins arising from the upper half of the blades and prominent tertiary veins, as well as by the long-pedunculate inflorescence with a narrowly ovate typically green spathe and short-tapered yellow spadix.

Type:—PANAMA. Veraguas: Santa Fe, Río Guayabalito, áreas boscosas en las proximidades del río, cercano al límite con la Provincia de Colón (Río Belén), 08°46'59"N, 80°47'07"W, 140 m, 17 Mar 2014, *A. Zapata 3533b* (holotype MO!).

Epiphytic at 3 to 9 m; **internodes** short, 3–4 cm diam.; **cataphylls** lanceolate, 13–19 cm long, acute at apex, persisting as a fine usually grayish network of fibers, mostly tightly appressed to stem. Leaves moderately long-petiolate, rosulate; **petioles** 19–50 cm long, 5-ribbed, broadly and sharply sulcate adaxially, prominently 3-ribbed abaxially, adaxial margins narrowly and sharply raised, drying pale yellow-green and weakly glossy; geniculum 0.5-1.0 (1.5) cm long; **blades** narrowly oblanceolate, 62–94 × 9–24 cm, broadest in the distal 2/3 of the blade, 3.9–7.6 times longer than wide, 1.9–4.2 times longer than petioles, narrowly long-acuminate at apex, narrowly acute to attenuate at base, moderately coriaceous, drying gray-green on both surfaces, nearly matte above, semi-glossy below; **midrib** narrowly rounded and concolorous above, narrowly acute and paler below; **primary lateral veins** 9–12 pairs, arising at 40–60° angle, weakly raised and narrowly rounded and concolorous above, acutely raised and paler below; **collective veins** arising from primary lateral veins in the distal half of the blade, 4–8 mm from margin; tertiary veins prominent on both surfaces; glandular punctations lacking; surfaces finely and irregularly granular-pustular. **Inflorescence** erect-spreading; **peduncle** 31–58 cm long, drying yellowish brown, 6–8 mm diam.; **spathe** erect, narrowly ovate to lanceolate, 15.5–16.5 × 2.0–3.7 cm, green; **spadix** pale yellow and matte at anthesis, green at pre-anthesis, short-tapered, 9.5–13.3 cm long, 6–8 mm diam., sessile to weakly stipitate (stipe 1.5 mm diam.); **flowers** 12–13 visible per spiral, 1.4–1.5 × 1.1–1.3 mm; tepals matte, smooth, lateral tepals 0.9–1.0 mm wide, inner margin rounded, outer margin 2–3-sided; stamens exserted at anthesis, anthers yellowish , 0.6 mm wide, 0.2 mm long. **Infructescence** pendent, **berries** yellow, conical.

Eponymy:—The species epithet is from the Latin "tenui" meaning slender or thin and "reticulum" meaning network, referring to the network of thin cataphyll fibers.

Habitat and distribution:—*Anthurium tenuireticulum* is endemic to Panama, known only from the type locality in Veraguas Province at 244 m in a *Premontane rain forest* life zone.

Phenology:—Flowering in May, March, April and fruiting in October.

Discussion:—This species is a member of sect. *Pachyneurium* and is very similar to *A. luteynii* Croat (1981: 324), *A. upalaense* Croat & Baker (1979: 97), *A. purpureospathum* Croat (1981: 328), *A. seibertii* Croat & Baker (1979: 85) and *A. validifolium* K. Krause (1932: 607). These five species comprise a species complex (*Anthurium validifolium* complex) characterized by having leaves with 5-ribbed petioles (3 ribs on the abaxial side and 2 additional ribs on the lower corners) and elliptic-oblong to oblong-lanceolate, coriaceous or subcoriaceous blades. Although all these species are significantly similar in their vegetative characteristics, all easily separate using its inflorescence or infructescence characters. *Anthurium seibertii* and *A. validifolium* typically occur above 600 m elevation and differ from *A. tenuireticulum* in having pale lavender to violet-purple spadices and reflexed spathes; *A. upalaense* and *A. purpureospathum*, which usually occur lower than 600 m elevation, differ in having green to purplish or reddish spadices, reflexed spathes and reddish berries, and *A. luteynii* differs by having dark purple, cucullate spathes and violet-purple spadices.

In the Lucid *Anthurium* key the species tracks to *A. bonplandii* Bunting (1975: 267), which differs by having mostly intact cataphylls, D-shaped petioles and linear-lanceolate spathes. Other species with similar features include *A. crassinervium* (Jacquin 1791: 122) Schott (1829: 828), which differs by its D-shaped to quadrangular petioles, lanceolate spathes and dark purple spadices; *A. fendleri* Schott (1860: 468), differing by its mostly intact cataphylls, D-shaped to subtriangular petioles, linear-lanceolate reflexed spathe and maroon spadix.

Conservation status:—This species is only known from five localities, of which only two are included in protected areas (Santa Fe National Park and Río Caimito Private Reserve). The remaining recorded locations are in

a mining area that is in operation, putting the species in obvious peril. We have calculated that this species has an estimated extent of occurrence of 462 km^2 and an area of occupancy of 20 km^2. Based on the information mentioned above, *A. tenuireticulum* qualifies as an endangered species [EN B1ab(ii,iii,iv,v)+B2ab(ii,iii,iv,v)].

Additional specimens examined (paratypes):—PANAMA. Colón: MPSA Concession, Valle Grande, Sierra 19, 08°49'54"N, 80°41'05"W, 291 m, 17 May 2012, *B. Hammel, J. De Gracia, J. Martínez, H. Quiel, & M. Merello 26233* (MO!); Distrito de Donoso, Área de concesión Minera Panamá (MPSA), 08°55'21" N, 80°40'41" W, 87 m, 3 Oct 2014, *R. Vergara 553* (PMA!); Concesión Minera Panamá, Valle Grande, Sierra 18, Plataforma CEP13, 08°50'15''N, 80°40'40''W, 195 m, 27 Oct 2014, *C. Ramos 397* (PMA!); Concesión Minera Panamá, Presa Norte, 8°53'28.9''N, 80°39'32''W, 112 m, 18 April 2014, *I. Vergara 356* (PMA!); Distrito de Donoso, Área de concesión de Minera Panamá, Botija, 8°50'14" N, 80°38'32" W, 137 m, 29 Jan 2014 (flowering specimen prepared from a collection in cultivation, 27 March 2019), *O.O. Ortiz 1969* (PMA!); Distrito de Donoso, Reserva Privada Río Caimito, 8°57'37" N, 80°42'16" W, 65 m, 27 Jan 2020, *O.O. Ortiz, C. Flores & B. Fuentes 3733* (PMA!); Distrito de Donoso, Reserva Privada Río Caimito, 08°57'45" N, 80°42'23" W, 64 m, 29 Jan 2020, *O.O. Ortiz, C. Flores & B. Fuentes 3742* (PMA!); Distrito de Donoso, Reserva Privada Río Caimito, 08°58'29" N, 80°42'13" W, 82 m, 30 Jan 2020, *O.O. Ortiz & B. Fuentes 3749* (PMA!).

FIGURE 22. *Anthurium tenuireticulum* Croat & O. Ortiz: **A**. Leaves. **B**. Stem and cataphylls. **C**. Infructescence. **D**. Inflorescence in its natural disposition. Photo credits: Orlando O. Ortiz. (A, D), Christel Ramos (B, C).

Anthurium tifense Croat & O.Ortiz, *sp. nov.* (Figs. 21D, 23)

Anthurium tifense is characterized by its epiphytic life form, short internodes, semi-intact and deciduous cataphylls, long-petiolate leaves, subterete brown-drying petioles; narrowly panduriform, short-acuminate brown-drying semiglossy blades with a spathulate to mitered sinus, 5–6 pairs of basal veins, none of which are free to the base, a weakly curved posterior rib, which is naked most of its length, 9–11 pairs of primary lateral veins, as well as by its long-pedunculate inflorescence with a green, oblong-oblanceolate, green reflexed-spreading spathe and oblong-tapered weakly stipitate spadix.

Type:—PANAMA. Coclé: Parque Nacional General de División Omar Torrijos Herrera, Caño Sucio, cloud forest on Alto Tife, moist forest with very rocky soil, 08°42'20"N, 80°38'05"W, 542 m, 17 July 2013, *O.O. Ortiz 1400* (holotype PMA!, isotype MO!).

Epiphytic; **internodes** short, 2 cm diam.; **cataphylls** deciduous. Leaves long-petiolate; **petiole** subterete, weakly sulcate, 79.5 cm long, drying 4 mm diam., drying dark brown, matte, finely ribbed; geniculum 1.1 cm long, darker and thicker; **blades** panduriform, 44.5–49.0 × 19.0–25.2 cm, 1.9–2.3 times as long as broad, broadest across the middle of the posterior lobes, 0.5 times as long as petioles, prominently constricted 8–9 cm above petiolar plexus, acute at apex with a short acumen, deeply lobed at base, subcoriaceous, dark green and semiglossy above, slightly paler, semiglossy below, drying dark gray-brown above, dark yellowish gray-brown below, semiglossy on both surfaces; **anterior lobe** 34–35 cm long, broadly convex above the constriction; **posterior lobes** 12–14 × 7–9 cm; upper surface densely granular, weakly short pale-lineate; lower surface weakly granular, sparsely and weakly short pale-lineate; **sinus** mitered to broadly spathulate, 10.5–11.0 cm deep, 4.7–6.0 cm wide; **primary lateral veins** 9–11 pairs, arising at 55–60° angle, those near the base very weak, narrowly raised and concolorus above, narrowly rounded to bluntly, darker below; tertiary veins prominulous on both surfaces; **collective veins** arising from the 1st pair of basal veins, 6–8 mm from margin, only weakly loop-connecting primary lateral veins; **basal veins** 5–6 pairs, none free to the base, 1st pair fused 1.3–1.7 cm, 2nd pair fused 2.3–2.9 cm, 3rd pair fused 3.5–4.0 cm, 4th pair fused 4.3–6.0 cm; posterior rib fused 4.4–6 cm long, curved, naked 4.5–5.7 cm; **midrib** broadly angular and concolorous above, drying prominently raised and darker, acute with 3–5 narrowly raised ribs on each side below. **Inflorescence** erect; **peduncle** 40.8 cm long, 2.5 mm diam. and gray-glaucous on drying, densely purplish punctate-lineate, the underlying epidermis reddish brown, semiglossy; **spathe** reflexed-spreading, oblong-oblanceolate, 4.5 × 1.0 cm, abruptly acuminate, green; **spadix** dried but seemingly purplish, 5 cm long, 4 mm diam., oblong-tapered, stipitate 1.5 mm; **flowers** 5–7 visible per spiral, 1.6 × 1.4 mm; tepals moderately smooth, lateral tepals 0.6 mm wide, inner margin rounded, outer margin 2-sided. **Berries** not seen.

FIGURE 23. *Anthurium tifense* Croat & O. Ortiz: **A**. habit. **B**. Cataphylls. **C**. Leaf blades (adaxial surface). Photo credits: Orlando O. Ortiz.

Eponymy:—The species is named for the type locality at Alto Tife in Coclé Province.

Habitat and distribution:—*Anthurium tifense* is endemic to Panama, known only from the type locality in the Province of Coclé at 542 m in a *Premontane rain forest* life zone.

Phenology:—Flowering in July.

Discussion:—The species is an unusual member of sect. *Cardiolonchium*. Owing to its panduriform blade the species is most similar to *A. panduriforme* Schott (1860: 536) which differs by its greenish drying blade with closely spaced primary lateral veins and a glossy lower surface with prominent tertiary veins, and to *A. argyrostachyum* Sodiro (1901: 11) which has thin greenish drying blades with numerous, closely spaced primary lateral veins and a long-tapered bluish green spadix.

Conservation status:—*Anthurium tifense* is known only from one location (Cerro Tife), which is included in the protected area of Omar Torrijos Herrera National Park. This species occurs in a rather inaccessible area, without settlements or disturbed sites. In the absence of population data, *A. tifense* can be assessed as data deficient (DD).

Anthurium tubualaense Croat & O.Ortiz, *sp. nov.* (Figs. 24, 25)

Anthurium tubualaense is characterized by its terrestrial life form, short internodes, intact cataphyll fibers eventually with scattered loose cataphyll fibers, the long, grayish brown-drying, terete petiole, large ovate-sagittate, grayish yellow-brown-drying blades with a narrowly hippocrepiform to nearly closed and spathulate sinus, 7 pairs of basal veins, 1–2 of which are free to the base, an almost straight posterior rib that is naked from 3/4 to nearly throughout its length, a round-raised midrib on upper surface, 8–9 primary lateral veins, collective veins arising from the upper primary lateral veins, as well as by the long-pedunculate inflorescence with an erect, green, subcoriaceous, linear-lanceolate, semiglossy spathe and a long-tapered, glossy, dark yellowish green spadix.

Type:—PANAMA. Comarca Guna Yala, Corregimiento de Tubuala No. 3, Comunidad de Sasardi Mulatupu, 08°54'38"N, 77°46'11"W, 91 m, 22 Jan 2014, *O.O. Ortiz, R.M. Baldini & G. Morales 1884* (holotype MO!, isotype PMA!).

FIGURE 24. Holotype specimen of *Anthurium tubualaense* Croat & O. Ortiz.

Terrestrial; **internodes** short, 3–4 cm diam.; **cataphylls** moderately thick, less than 10 cm long, initially intact, evenually fibrous; fibers to 13 cm long, pale brown, loosely associated. Leaves with **petioles** 69–101 cm long, terete, drying grayish yellow-brown, narrowly and obtusely sulcate abaxially; geniculum 2.5 cm long, drying slightly darker; **blades** narrowly ovate-sagittate, 65–66 × 37.5–39.5 cm, 1.6–1.7 times longer than wide, about as long as petioles, broadest near the petiolar plexus or midway between the petiolar plexus and the base, acuminate at apex, deeply lobed at base, moderately coriaceous, dark green and weakly glossy above, moderately paler and semiglossy below, drying weakly glossy and yellow-brown above, yellow-brown and semiglossy below; **anterior lobe** 42.5–44.0 cm long, broadly convex along margins; **posterior lobes** 23.0–25.0 × 15.0–16.5 cm; both surfaces smooth, unmarked; **sinus** narrowly hippocrepiform to spathulate and almost closed, 20.0–20.5 cm deep, 4.5–6.0 cm wide; **midrib** narrowly rounded and concolorous above, round-raised, several-ribbed and nearly concolorous, matte below; **primary lateral veins** 7–8 pairs, arising at steep (narrow) angle then spreading at 55–60° angle, mostly joining the margin, narrowly rounded and concolorous above, round-raised, finely ribbed, and concolorous below; tertiary veins prominent on lower surface; **collective veins** arising from the upper primary lateral veins, 2 mm from the margin; **basal veins** 7 pairs, 1–2 pairs free to the base; 2nd pair sometimes fused 1.8 cm; 3rd pair fused 2.0–3.5 cm, 4th pair fused 4.0–4.5 cm; 5th pair fused 5.5–6.0 cm; **posterior ribs** 6.5–8.0 cm long, weakly curved, naked 9.6 cm; surfaces moderately smooth but finely granular at higher magnification. **Inflorescences** erect; **peduncle** 75–80 cm long, drying gray-brown, weakly glossy; **spathe** 17.0–24.5 × 2.0–2.5 cm, subcoriaceous, erect, narrowly long-acuminate, green, semiglossy; **spadix** long-tapered, medium dark green and glossy, 13 cm long, ca. 1 cm diam., drying to 6 mm diam.; **flowers** 10–11 visible per spiral; 1.6–1.8 × 1.2 mm; tepals matte; lateral tepals 8–9 mm wide, inner margin rounded, outer margins 2-sided. **Infructescence** with persistent green spathe. **Berries** early-emergent, purplish violet.

Eponymy:—The species is named for the type locality in Corregimiento Tubuala in Guna Yala Comarca.

Habitat and distribution:—*Anthurium tubualaense* is endemic to Panama, known only from the type locality in Comarca Guna Yala at 91 m elevation in a *Tropical wet forest* life zone.

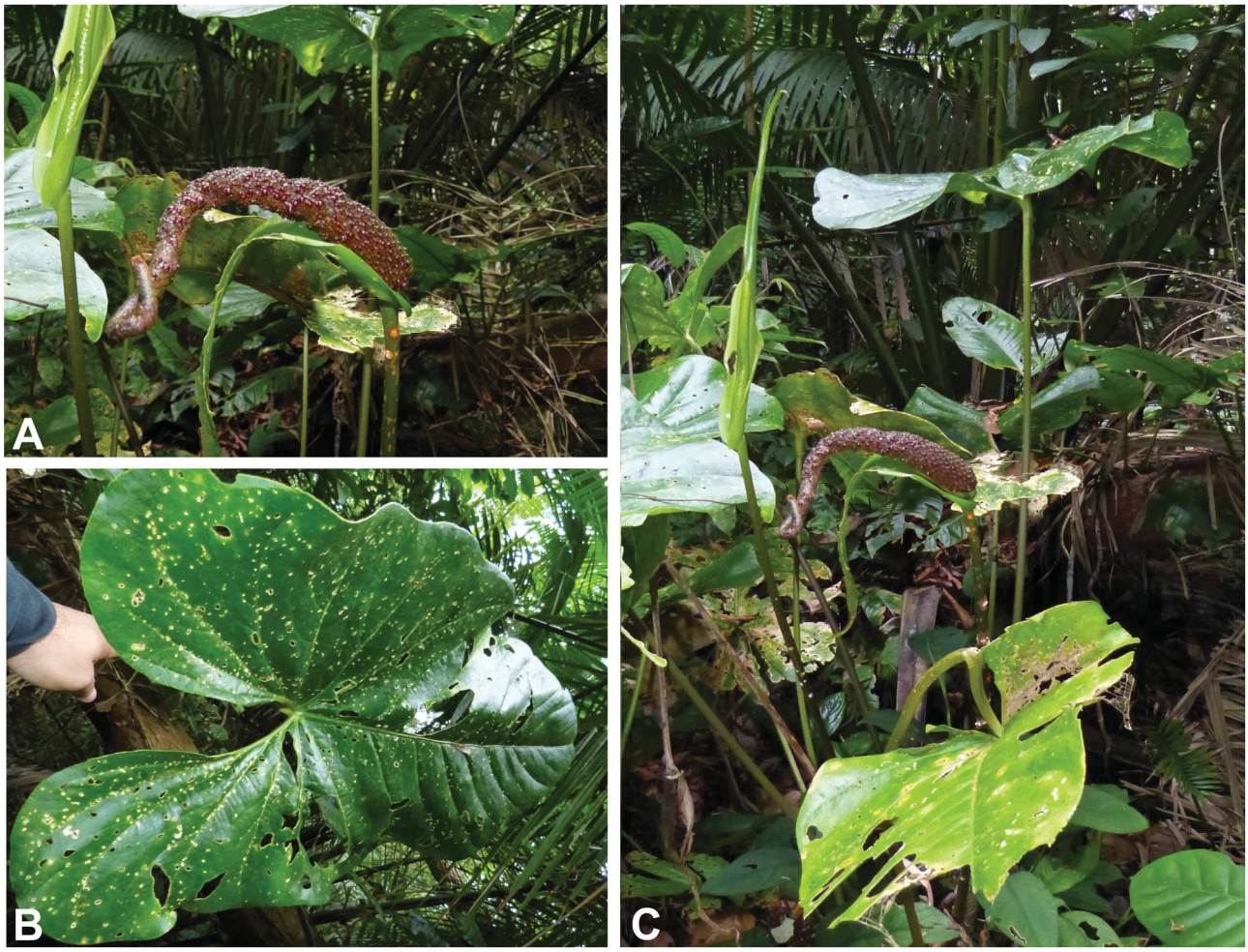

FIGURE 25. *Anthurium tubualaense* Croat & O. Ortiz: **A**. Infructescence. **B**. Leaf blade (adaxial surface). **C**. Habit with the inflorescence and infructescence. Photo credits: Orlando O. Ortiz.

Phenology:—Flowering and fruiting in January.

Discussion:—*Anthurium tubualaense* is a member of sect. *Cardiolonchium* and might be most easily confused with *A. dukei* Croat, another similar member of this section. The last species differs by having leaf blades with numerous primary lateral veins (12–20 pairs) and collective veins arising from the lowermost basal veins and red berries. In the Lucid *Anthurium* key *A. tubualaense* tracks to *A. angamarcanum* Sodiro (1901: 12), an Ecuadorian species that differs in having leaf blades with numerous basal veins (8–11 pairs) and a dark purple spadix; *A. incurvatum* Engler (1898: 445), a species from western Ecuador which differs by having much shorter, more prominently curved posterior ribs usually less than 3.5 cm, more prominent tertiary venation and more prominently persistent cataphylls; *A. velutinum* Engler (1898: 433), which differs by having 3–6 pairs of basal veins with major veins on the scabrid upper blade surfaces, and *A. walujewii* Regel (1879: 290) from Cauca Department in Colombia, which differs by its 4–5-sided petiole, the small blade less than 53 cm long and 25 cm wide and only 1.3 times longer than broad, as well as by its reddish spadix.

Conservation status:—Data deficient (DD).

New taxonomic *status* and names

***Anthurium arcuatum* (Croat) O.Ortiz & Croat, *stat. nov.* (Fig. 26)**

Basionym: Anthurium protensum Schott subsp. *arcuatum* Croat, Monographs in Systematic Botany from the Missouri Botanical Garden 14: 164–165 (1986b).

Type:—PANAMA. Chiriquí: above San Félix along mining road, 25 mi. off Pan-American Highway, 08°32'N, 81°49'W, 1500 m, *T.B. Croat 33138* (holotype MO!, isotypes F!, K!, PMA!, US!).

Habitat and distribution:—*Anthurium arcuatum* is known principally from Costa Rica to western Panama and occurs in *Premontane rain forest* at 775–2250 m.

Discussion:—*Anthurium arcuatum* is distinguished by having slender, short stems, more or less oblong leaf blades, erect inflorescences, ovate to broadly lanceolate purplish cucullate spathes and cylindroid spadices whitish-lavender at anthesis and reddish-purple at post-anthesis. *Anthurium arcuatum* and *A. protensum* Engl. have in common certain vegetative characteristics such as the shape and width of the leaf blades, however both species can be clearly differentiated using mainly the characteristics of their inflorescences. *Anthurium protensum* differs from *A. arcuatum* in having typically much larger leaf blades (rarely less than 50 cm long), with obscure primary lateral veins (when dry), usually acute at the base (vs. obtuse to rounded in *A. arcuatum*), thicker petioles (5–7 mm diam. vs. 3–4 mm diam.), pendent inflorescences (vs. erect inflorescences), oblong-lanceolate yellow-green spathes (usually at least tinged with purple) (vs. ovate to broadly lanceolate solid reddish violet spathes) and pale violet-purple sessile long-tapered (8–12 cm long) spadices (vs. whitish-lavender cylindroid stipitate spadices of up to 5 cm long).

Additional specimens examined:—COSTA RICA. Heredia: R.F. cordillera Volcanica central, cuenca del Sarapiqui, 9 km al NE Vara Blanca, hacia finca Murillo a orillas del camino, Proyecto ALAS, 10°14'11"N, 84°07'04"W, 1450–1550 m, 11 Apr 2005, *D. Santamaría 1506* (INB!, MO!). Puntarenas: Reserva Biológica Monteverde Sendero San Luis, bosque muy húmedo, premontano, 10°18'00"N, 84°48'00"W, 1450 m, 9 Jan 1987, *W.A. Haber, E. Bello C. & J. Gaw 6501* (MO!); Monteverde Cloud Forest Reserve, 10°18'00"N, 84°47'24"W, 1520 m, 14 Feb 1987, *P. Lesica & R. Antibus 4184* (MO!). PANAMA. Bocas del Toro: Near headwaters of Río Culebra ca. 5 km ENE of Cerro Pate Macho, NE of Boquete and E of Finca Serrano, Forest, 08°50'18"N, 82°19'30"W, 1524 m, 11 Feb 1979, *B.E. Hammel 6136* (MO!). Chiriquí: Along trail on continental divide, vicinity of Fortuna Dam, 08°45'59"N, 82°12'44"W, 1200 m, 26 Apr 1986, *G. McPherson 9035* (MO!); Along trail on continental divide, vicinity of Fortuna Dam, 08°45'59"N, 82°12'44"W, 1200 m, 26 Apr 1986, *G. McPherson 9051* (MO!); Ca. 5 km ENE of Cerro Pate Macho near Finca Serrano, across the divide, NE of Boquete, 1676 m, 08°50'00"N, 82°19'54"W, 17 Feb 1979, *B.E. Hammel 6254* (MO!); Along Continental Divide from road branching N off main Fortuna-Chiriquí Grande Highway near Continental Divide, 1.1 mile from main highway, 08°44'00"N, 82°17'00"W, 1200 m, 11 Mar 1985, *T.B. Croat & M.H. Grayum 60295* (MO!); Fortuna Dam area, along Quebrada Bonito to E of road, 08°45'00"N, 82°13'00"W, 1100 m, 8 Feb 1984, *H.W. Churchill, G.C. de Nevers & H. Stockwell 4818* (MO!); Fortuna Dam area, along Quebrada Bonito to E of road, 08°45'00"N, 82°13'00"W, 1100 m, 8 Feb 1984, *H.W. Churchill, G.C. de Nevers & H. Stockwell 4819* (MO!); Along

highway between Gualaca and Chiriquí Grande, along boundary trail between Bocas del Toro Province and Chiriquí Province, beginning from gravel road which leads W off main pavement just S of Continental Divide, 1170–1250 m, 08°45'00"N, 82°18'00"W, 26 Jun 1987, *T.B. Croat 66839* (MO!); Cuesta de Las Palmas, S slope of Cerro de la Horqueta, 08°50'00"N, 82°27'00"W, 1700–2100 m, 17–19 Mar 1911, *H. Pittier 3160* (NY!); Cuesta de Las Palmas, S slope of Cerro de la Horqueta, 08°50'00"N, 82°27'00"W, 1700–2100 m, 17–19 Mar 1911, *H. Pittier 3161* (US!); Forests along the Río Ladrillo and vicinity, above El Boquete, 1200–1300 m, 08°48'00"N, 82°27'00"W, Mar 1911, *H. Pittier 3062* (US!); About 1 km north of Las Nubes, east of the mountain of Cerro Punta and about 5 km northwest of the town of Cerro Punta, wooded slopes, 08°53'00"N, 82°34'00"W, 2000–2300 m, 24 Dec 1971, *R.L. Wilbur, F. Almeda, J.L. Luteyn & J.F. Utley 15235* (DUKE!); About 1 km north of Las Nubes, east of the mountain of Cerro Punta and about 5 km northwest of the town of Cerro Punta, wooded slopes, 08°53'00"N, 82°34'00"W, 2000–2300 m, 24 Dec 1971, *R.L. Wilbur, F. Almeda, J.L. Luteyn & J.F. Utley 15236* (DUKE!); About 1 km north of Las Nubes, east of the mountain of Cerro Punta and about 5 km northwest of the town of Cerro Punta, wooded slopes, 08°53'00"N, 82°34'00"W, 2000–2300 m, 24 Dec 1971, *R.L. Wilbur, F. Almeda, J.L. Luteyn & J.F. Utley 15252* (DUKE!); About 1 km north of Las Nubes, east of the mountain of Cerro Punta and about 5 km northwest of the town of Cerro Punta, wooded slopes, 08°53'00"N, 82°34'00"W, 2000–2300 m, 24 Dec 1971, *R.L. Wilbur, F. Almeda, J.L. Luteyn & J.F. Utley 15252* (DUKE!); Along the upper Río Chiriquí Viejo about 2 km NE of Guadeloupe which is about 2 km north of Cerro Punta Weedy trail and forested slopes, 08°52'00"N, 82°33'00"W, 2250 m, 25 Dec 1971, *R.L. Wilbur, F. Almeda, J.L. Luteyn & J.F. Utley 15377* (DUKE!); 9 km past divide in road to Alto Quiel from Boquete, 08°49'00"N, 82°28'00"W, 1930 m, 19 Feb 1986, *W. Scott Hoover 1341* (MO!); Fortuna Dam area, trail along Continental Divide to W of Oleoducto road, leading to unnamed ridge top, 08°47'00"N, 82°13'00"W, 1200–1500 m, 25 May 1984, *H.W. Churchill 5306* (MO!); Along road between Fortuna Lake and Chiriquí Grande, 4.5-5 km N of dam over Fortuna Lake, 08°45'00"N, 82°13'00"W, 1100–1135 m, 8 Mar 1985, *T.B. Croat 60077* (B!, CM!, K!, MO!, PMA!). Coclé: El Valle de Antón Region, at La Mesa, 3.2 mi above El Valle, small patch of cloud forest on flat area, 0.1 km E of Finca Macarenita, 08°36'00"N, 80°07'00"W, 775 m, 25 Mar 1993, *T.B. Croat 74790* (CM!, MO!). Comarca Ngäbe-Buglé: Cerro Colorado, 9.2 miles W of Chamé, along trail E of road which leads down to stream, 08°35'00"N, 81°50'00"W, 1450–1480 m, 6 Jul 1988, *T.B. Croat 69071* (B!, CAS!, F!, MO!, US!); Cerro Colorado; road along top, border of Chiriqui-Bocas del Toro provinces, 08°32'19"N, 81°48'42"W, 1500–1750 m, 13 Aug 1977, *J.P. Folsom, G. Small & R. Robbins 4693* (MO!); Along continental divide on Cerro Colorado, on upper mining road 20–28 miles from San Félix, cloud forest, 08°35'21"N, 81°50'02"W, 2000 m, 22 Nov 1979, *T.B. Croat 48461* (MO!); Cerro Colorado, 50 km N of San Félix on the continental divide, cloud forest, 08°32'00"N, 81°49'00"W, 1200–1500 m, 14 Mar 1976, *T.B. Croat 33369* (MO!); Cerro Colorado, 50 km N of San Félix on the continental divide, loud forest, 08°31'54"N, 81°48'48"W, 1200–1500 m, 17 Aug 1975, *S.A. Mori & R.L. Dressler 7770* (MO!); Cerro Colorado, along road above San Félix ca. 30 km above bridge over Río San Félix (7.9 km above turnoff to Escopeta), disturbed primary forest, 08°32'17"N, 81°48'42"W, 1610–1670 m, 14 Jul 1976, *T.B. Croat 37111* (MO!); Cerro Colorado, along road above San Félix ca. 30 km above bridge over Río San Félix (7.9 km above turnoff to Escopeta), disturbed primary forest, 08°32'17"N, 81°48'42"W, 1610–1670 m, 14 Jul 1976, *T.B. Croat 37132* (MO!); Cerro Colorado, along road to copper mine development N of San Félix, 20.5 mi N of the bridge near San Félix, 8.3 mi beyond Chame and turnoff to Escopeta, 08°32'19"N, 81°48'41"W, 1630 m, 30 Mar 1993, *T.B. Croat 75043* (MO!); Kankintú, quebrada Hacha, faldas del Cerro Santiago, orilla del río, área intervenida, 08°30'40"N, 81°46'18"W, 1429 m, 4 Sept 2012, *M. Ayala, A. Ibáñez, A. Celis & R. Flores 1512 MA* (MO!). Veraguas: Ridge of Cordillera de Tute, along trail to Cerro Tute, ca 3–4 km past Escuela Agricola Alto de Piedra, just W of Santa Fé, Premontane and montane rainforest, 08°32'00"N, 81°07'00"W, 800–1400 m, 20 Mar 1982, *S. Knapp & W.J. Kress 4353* (MO!); Ridge of Cordillera de Tute, trail to Cerro Tute, above Escuela Agricola Alto de Piedra, just W of Santa Fé, premontane wet forest, 08°32'00"N, 81°07'00"W, 800–1350 m, 5 Jun 1982, *S. Knapp & R.L. Dressler 5407* (MO!); In forest below summit of Cerro Arizona, above Santa Fe, 1219 m, 08°29'25"N, 81°06'50"W, 22 Apr 1980, *B.E. Hammel & J. Kress 8570* (MO!); Cerro Tute; E slope, 1 km beyond Escuela Agricola Alto Piedra above Santa Fe, low cloud forest to elfin forest, 1200–1450 m, 08°30'35"N, 81°07'37"W, 14 May 1981, *K.J. Sytsma & T.M. Antonio 4587* (MO!); Along main path to top of Cerro Tuté above Agricultural school N of Santa Fe, 08°31'26"N, 81°07'55"W, 1200 m, 19 Jun 1980, *J.P. Folsom & J.D. Mauseth 8344* (MO!); Slopes of Cerro Tute, near Escuela Agricola Alto Piedra; virgin forest along trail to summit, 1250–1350 m, 08°30'22"N, 81°07'18"W, 30 Nov 1979, *T.B. Croat 48964* (F!, MO!, US!); NW del Cerro San Antonio, cerca del filo de la Cordillera, bosque nuboso, 1600 m, 13 Oct 2009, *A. Ibáñez, F. Hernández, D. López & M. Ortega 5908* (PMA!).

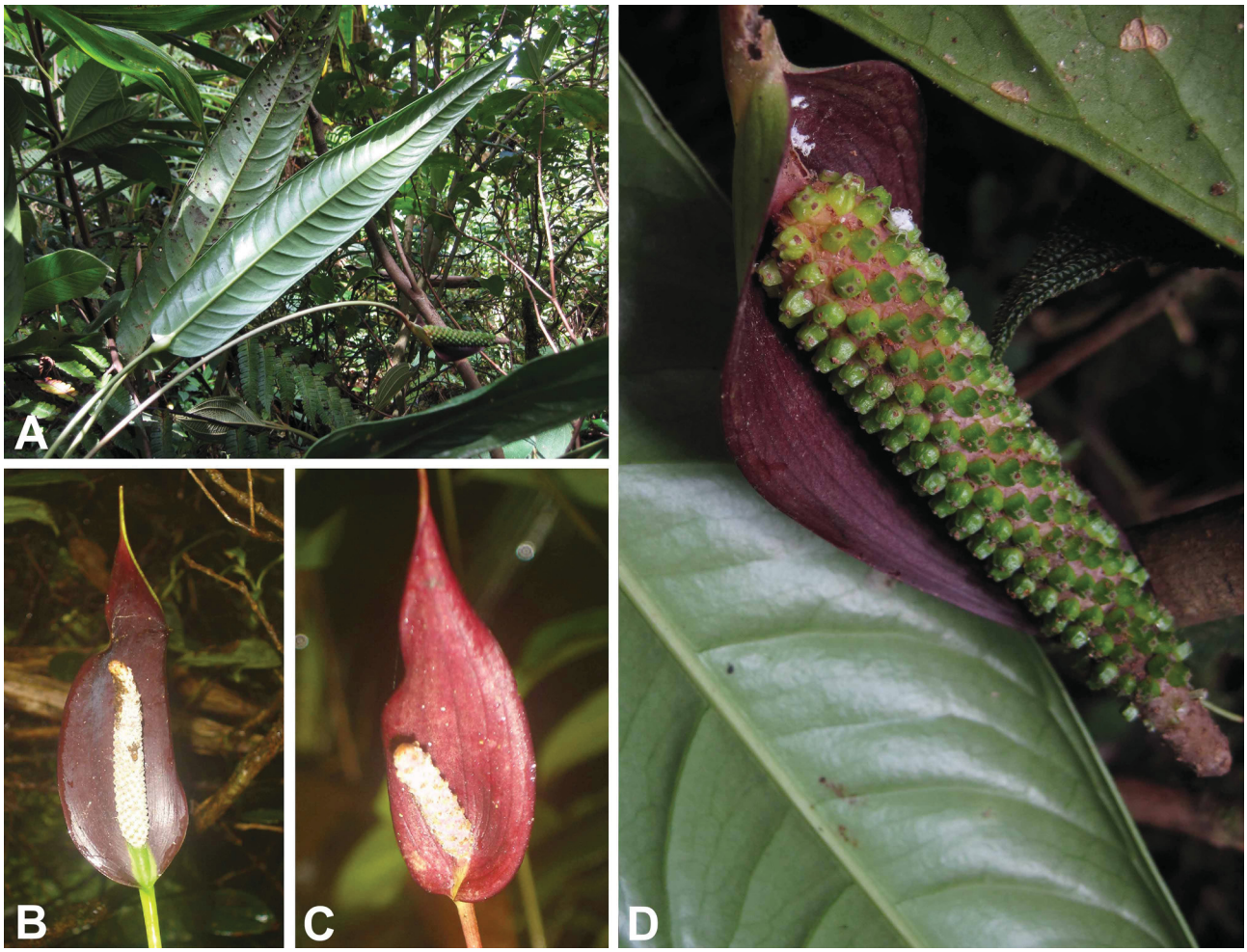

FIGURE 26. *Anthurium arcuatum* (Croat) O. Ortiz & Croat: **A**. Leaf blades (abaxial surfaces). **B**. Inflorescence (female anthesis). **C**. Inflorescence (male anthesis). **D**. Infructescence (immature). Photo credits: Alicia Ibáñez.

Anthurium copense O.Ortiz, M.Cedeño & Croat, *stat. et nom. nov.* (Fig. 27)

Basionym: Anthurium pittieri Engler var. *morii* Croat, Monographs in Systematic Botany from the Missouri Botanical Garden 14: 159–160 (1986b), non *Anthurium morii* Mayo & Haigh (in Haigh *et al.* 2011).

Type:—PANAMA. Coclé: Alto Calvario cloud forest along Continental Divide above sawmill, 5.2 mi. N of El Copé, 930 m, *T.B. Croat 49180* (holotype MO!, isotypes K!, PMA!, SEL!).

Eponymy:—A new name is proposed for this taxon, because the name *A. morii* Mayo & Haigh is a previously and validly published name at species rank. The species is named for the type locality in El Copé in Coclé Province.

Habitat and distribution:—This species is endemic to western Panama from Chiriquí, Bocas del Toro to Coclé Provinces at 800 to 2066 m in *Premontane* and *Lower montane rain forest* life zones.

Discussion:—This taxon has long been considered as a variety of *A. pittieri*, but both entities usually occur in very different habitats and have markedly different morphological characteristics, therefore, we propose to consider *Anthurium pittieri* var. *morii* as a distinct taxon at the species level, using the new name *A. copense*. *Anthurium pittieri* usually occurs in lowland forests from near sea level and in cloud forests up to 2000 m (averaging 800 m), whereas *A. copense* generally occurs in cloud forests, ranging from 750 to about 2000 m (averaging 1200 m). *Anthurium pittieri* differs from *A. copense* in having usually short internodes (up to 1.5 cm long vs. up to 8 cm long), thick and short stems (up to 20 cm long and 1–2 cm diam. vs. up to 95 cm long and 0.5–0.8 cm diam.), smooth nodes (vs. ring-shaped nodes), usually longer blades (10–43 cm long vs. 7–14 cm long) with numerous primary lateral veins (17–20 pairs vs. 7–11 pairs), larger spathes (7.0–15.0 × 1.2–2.5 cm vs. 2.2–4.0 × 0.6–1.0 cm) and typically larger spadices (11.0–14.5 cm long, 7–8 mm diam. vs. 1–4 cm long, 2–3 mm diam.).

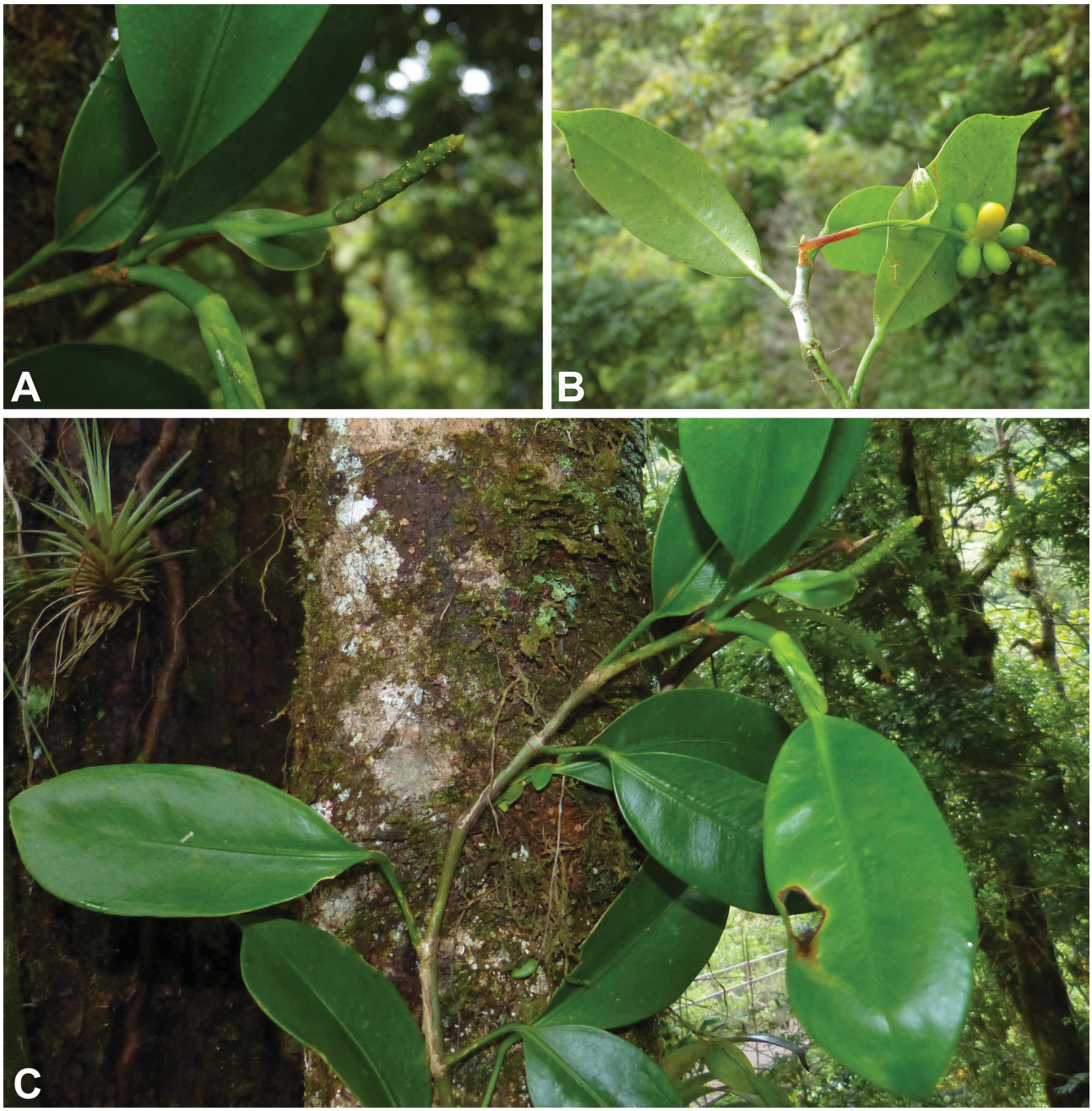

FIGURE 27. *Anthurium copense* O. Ortiz, M. Cedeño & Croat: **A**. Inflorescence. **B**. Infructescence and leaf blade (abaxial surface). **C**. Habit. Photo credits: Orlando O. Ortiz.

Additional specimens examined:—PANAMA. Chiriquí: Along trail on continental divide. Vicinity of Fortuna Dam, 1200 m, 08°45'59"N, 82°12'44"W, 26 Apr 1986, *G. McPherson 9036* (MO!); Fortuna Dam area, Trail along Continental Divide to W of Oleoducto road, leading to unamed ridge top, 08°47'00"N, 82°13'00"W, 1200–1500 m, 25 May 1984, *H. W. Churchill 5301* (MO!); Fortuna Dam area, S of reservoir, trail to E of road leading to Quebrada Ortega, 08°41'00"N, 82°14'00"W, 1200 m, 25 May 1984, *H.W. Churchill 5330* (MO!); Fortuna Dam area, Along Quebrada Bonito to E of road, 08°45'00"N, 82°13'00"W, 1100 m, 8 Feb 1984, *H.W. Churchill, G.C. de Nevers & H. Stockwell 4806* (MO!); Fortuna, Cordillera Central, 08°47'00"N, 82°12'00"W, 1075 m, 7 Dec 1996, *E. Montenegro 1596* (MO!, PMA!); Boquete, Tree Trek Mountain Resort, 08°48'56"N, 82°23'17"W, 1958 m, 24 Aug 2018, *O.O. Ortíz, R.M. Baldini, R. Flores, M. Cedeño-Fonseca, P. Diaz & H. Hentrich 3365* (MO!, PMA!); Boquete, Tree Trek Mountain Resort, 08°48'56"N, 82°23'17"W, 1958 m, 19 May 2017, *O.O. Ortíz, R. Flores, M. Cedeño-Fonseca & E. Jiménez 2781* (MO!, PMA!); 3.5 miles NE of Boquete, end of road along Río Palo Alto, 08°49'09"N, 82°23'52"W, 1890 m, 18 Nov 1978, *B.E. Hammel 5712* (MO!). Comarca Ngäbe-Buglé: Cerro Colorado, border of Chiriquí and Bocas del Toro provinces, along intersection of Bocas Road with main ridge road, 11.8 km from Chami [Chame] along

path headed into Bocas del Toro, 1400–1700 m, 24 Oct 1977, *J. P. Folsom 6130* (MO!); Cerro Colorado, on road, 35.6 km. from Río San Félix bridge, 08°31'56"N, 81°49'15"W, 1390 m, 15 Jul 1976, *G.A. Sullivan 394* (MO!); Cerro Colorado, on continental divide, 08°31'57"N, 81°49'45"W, 1400 m, 25 Jul 1979, *T.M. Antonio 1435* (MO!); Cerro Colorado, above San Félix along mining road 18–27 miles off of Pan-American Highway (above Chame or turn- off to Escopeta), 1200–08°32'00"N, 81°49'00"W, 1500 m, 12 March 1976, *T.B. Croat 33130* (MO!); Cerro Colorado, along road to copper mine, 34–35.6 km above the Río San Félix, (13–14.6 km beyond turnoff to Escopeta). Disturbed primary forest, cloud forest, 08°31'15"N, 81°47'36"W, 1390–1410 m, 15 Jul 1976, *T.B. Croat 37249* (MO!). Coclé: Alto Calvario, cloud forest, 800–900 m, 08°40'30"N, 80°36'30"W, 20 Apr 1977, *J.P. Folsom & A. Jaslon 2682* (MO!); Near continental divide along lumber road 5.2 mi N of El Cope, 1.5 mi N of lumber camp, cloud forest on steep slopes, 08°40'20"N, 80°35'44"W, 900 m, 19 Jan 1978, *T.B. Croat 44552* (MO!); El Potroso, Summit of Mountain Mist forest, along mountain ridge, trees failry short on the ridge top, but not slopes, forgotten works, Alto Calvario, 08°40'31"N, 80°36'31"W, 1 Feb 1977, *J.P. Folsom & L. Collins 1545* (MO!, SEL!); Summit at Alto Calvario, low montane cloud forest, ridge-type vegetation, 08°40'30"N, 80°36'37"W, 900 m, 4 Apr 1977, *J.P. Folsom & R. Robinson 2410* (MO!); On ridge W of Sawmill above El Copé, Pacific drainage, 853–1097 m, 08°40'00"N, 80°37'00"W, 21 Jun 1978, *B.E. Hammel 3565* (MO!); Cerro Tigrero, 1000–1350 m, 08°37'33"N, 80°41'18"W, 26–28 Sep 2001, *J.A. Mendieta 17-419* (MO!, PMA!); Alto Calvario, above saw mill, on Continental Divide, 5.2 mi above El Copé, cloud forest, 08°40'16"N 080°36'44"W, 930 m, 6 Dec 1979, *T.B. Croat 49180* (MO!); Camino al Cerro Blanco, alrededor de la cima, 08°40'16"N, 80°36'01"W, 2001, *J.A. Polanco 3992* (MO!, PMA!). Veraguas: Cerro Tute, ca. 10 km NW of Santa Fe, on ridgetop in cloud forest (Lower Montane Rain Forest), 08°28'56"N, 81°05'53"W, 1000 m, 19 Jun 1975, *S.A. Mori 6745A* (MO!).

***Anthurium fogdeniorum* (Croat) O.Ortiz, M.Cedeño & Croat, *stat. nov.* (Fig. 28)**

Basionym: Anthurium pittieri Engler var. *fogdeniorum* Croat (as '*fogdenii*'), Annals of the Missouri Botanical Garden 70: 350–351 (1983); Grayum, Manual de Plantas de Costa Rica Vol. II: 96 (2003).

Type:—COSTA RICA. Guanacaste: along the road between Santa Elena and Monteverde, ca. 2 mi from Santa Elena-Monteverde junction, 10°18'00"N, 84°47'24"W, ca. 1350 m, *T.B. Croat 47134* (holotype MO!, isotypes CR!, K!, SEL!, US!).

Habitat and distribution:—This species is endemic to Costa Rica and occurs in the vicinity of Monteverde. It is known only from the type locality in *tropical wet* or *premontane wet forest* life zones.

Discussion:—*Anthurium fogdeniorum* represents another entity that has long been considered as a subordinate taxon of *A. pittieri*, however, we consider that both entities have substantial distinctive morphological characteristics. *Anthurium pittieri* differs from *A. fogdeniorum* in having leaves with an obscure geniculum when dry (vs. leaves with a conspicuous, longer geniculum of 2.0–3.5 cm long), typically larger (10–43 cm long) oblong leaf blades (vs. shorter ovate to ovate-elliptic leaf blades of 4.5–14.0 cm long), numerous (17–20 pairs) primary lateral veins that are ± obscure above when fresh (vs. 5–10 pairs of primary lateral veins that are evident above), usually larger (7.0–15.0 × 1.2–2.5 cm) oblong-lanceolate spathes (vs. elliptic to obovate spathes of 2.0–5.2 × 0.6–1.5 cm) and larges spadices (11.0–14.5 cm long, 7–8 mm diam. vs. 1.5–4.0 cm long, 3–4 mm diam.). Also, *A. pittieri* usually occurs in lowland forests from near sea level or in cloud forests (averaging 800 m). In turn, *A. fogdeniorum* typically occurs in cloud forests, ranging from 1100 to 1700 m (averaging ca. 1400 m). Preliminary anatomical studies suggested that this species has a unique vascular arrangement in the genus (Bill Carvel pers. comm.).

The variety epithet was amended as "*fogdeniorum"* in Grayum (2003), due to the fact that the taxon was originally dedicated to two people (Mike and Patricia Fogden) (Croat 1983).

Additional specimens examined:—COSTA RICA. Boundary of Alajuela and Puntarenas: along Continental Divide, Cerros Centinelas, Monte Verde reserve, Cordillera de Tilarán, 10°18'00"N, 084°46'48"W, 1550–1600 m, 5 Jun 1986, *M.H. Grayum, P. J. Sleeper & R. Sleeper 7592* (MO!). Alajuela: Monteverde Reserve, Saino trail from Brillante in elfin forest on continental divide to Peñas Blancas valley, Lower montane rain forest on Atlantic slope, 10°20'00"N, 84°50'00"W, 1250–1500 m, 18 Oct 1985, *W.A. Haber & E. Bello C. 3303* (MO!); Bijagua El Pilón, ladera Atlántica del Volcán Tenorio, cuenca alta del Río Celeste, 10°43'12"N, 85°00'00"W, 1500 m, 23 Jul 1988, *G. Herrera Ch. 2147* (MO!); Vicinity of Monte Verde Preserve on property of Mike and Patricia Fogden. Steep slope in mature virgin forest, 10°18'00"N, 84°48'00"W, 31 Jan 1979, *T.B. Croat 46771* (MO!); SW slope of Volcán Orosí, Cordillera de Guanacaste, 10°58'00"N, 85°28'30"W, 1100–1400 m, 24 Aug 2007, *M.H. Grayum & A. Rojas 12907* (CR!, MO!); SW (Pacific) slope of Cerro Cacao, Cordillera de Guanacaste, 10°55'53"N, 85°27'35"W, 1300–1550

m, 8 Aug 2007, *M.H. Grayum, A. Soto & D. García 12536* (CR!, MO!); P.N. Guanacaste, Cordillera de Guanacaste, Estación Cacao, Cerro Cacao, 10°55'12"N, 85°27'36"W, 1100 m, 10 Feb 1995, *C. Cano 172* (B!, CR!, INB!, MO!, WU!); Cerro entre Cerro Chimú y Cerro Matama, 09°51'00"N, 83°14'24"W, 1200 m, 29 Apr 1985, *L.D. Gómez P. & G. Herrera Ch. 23541* (MO!); Cerro entre Cerro Chimú y Cerro Matama, 09°51'00"N, 83°14'24"W, 1200 m, 29 Apr 1985, *L.D. Gómez P. & G. Herrera Ch. 23534* (MO!); Monteverde Reserve, Cerro Amigos in area of TV towers, cloud forest, 10°20'00"N, 84°50'00"W, 1600–1700 m, 10 Oct 1985, *E. Bello C. 3303* (MO!); Ojo de Agua - Monteverde Finca Leonel Hernández, 10°18'00"N, 84°47'24"W, 1350 m, 7 Feb 1979, *T. B. Croat 47134* (MO!); Reserva Biológica Monteverde Ojo de Agua, Finca de Leonel Hernández Bosque pantanoso semiachaparrado, lado Pacífico de la reserva, 10°17'00"N, 84°46'00"W, 1550 m, 18 Jun 1987, *W.A. Haber & E. Bello C. 7308* (MO!); Reserva Biológica Monteverde Ojo de Agua, Finca de Leonel Hernández Bosque pantanoso semi-achaparrado, lado Pacífico de la reserva, 10°15'00"N, 84°46'00"W, 1600 m, 18 Nov 1987, *W.A. Haber & E. Bello C. 7791* (MO!); R.B. Monteverde; Cord. de Tilarán. Montes de Oro, Cerro Ojo de Agua, Est. Leonel Hernández, 10°14'24"N, 84°39'36"W, 1600 m, 24 Aug 1993, *E. Bello C. & E. Cruz L. 5238* (CR!); Monteverde, road to TV Tower, 10°18'36"N, 84°47'24"W, 1700 m, 24 Aug 1985, *W.A. Haber 2401* (MO!); Sendero San Luis, 10°16'54"N, 84°47'20"W, 1400 m, 27 Aug 1985, *W.A. Haber & E. Bello C. 2473* (MO!)

FIGURE 28. *Anthurium fogdeniorum* (Croat) O. Ortiz, M. Cedeño & Croat. Photo credits: Thomas B. Croat.

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